ENGINEERING NEWS-RECORD

JULY 11, 1946

In This Issue:

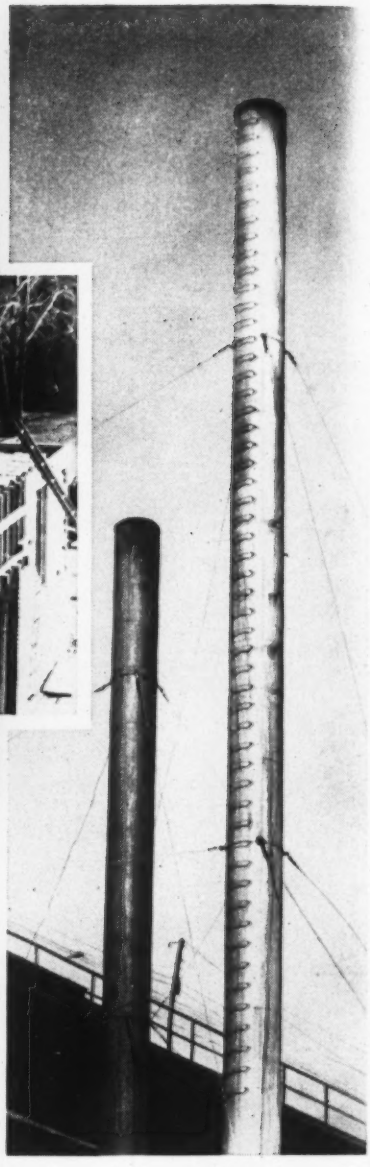
[illegible] CANCAIR [illegible]
[illegible] ARMY AIRCRAFT

FLEXIBLE PAVEMENTS FOR AIRPORT RUNWAYS

[illegible] POINT SYSTEM USED IN COMPACTING SAND FILL

Widening a 27-year-old concrete pavement in Delaware as the first step in a salvaging program

BYERS WROUGHT IRON serves at both ends of this Industrial Heating Job



The Gibsonburg Lime Products Company of Gibsonburg, Ohio, recently erected a 70-ft. stack to serve a new boiler, and installed radiant heating in a new plant office building. In both these services, corrosion is the major threat to long service life. In both, the same time-tried material was selected to combat corrosion—Byers Wrought Iron.

It is always interesting to know what evidence has influenced the choice of materials. In this case, it was the report of an elderly engineer friend, who told of wrought iron stacks that had served for periods up to 45 years, with no repairs or replacements. The choice of Byers Wrought Iron pipe for the radiant heating system followed accepted engineering practice. Of the thousands of successful radiant heating installations now operating, an overwhelming majority are of course wrought iron.

If you are considering a new stack, you will find it profitable to investigate the record of Byers Wrought Iron. Conditions vary so widely that it is unsound to generalize about probable life. But in any application where an unlined metal stack can be properly used, the weight of evidence indicates that wrought iron can be expected to serve longer. In the case of radiant heating, wrought iron not only offers corrosion resistance, but a combination of other qualities that recommend it: easy fabrication; a coefficient of expansion and contraction almost identical with that of concrete and plaster; and high heat emission.

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An index for Volume 136 (January-June 1946) will be published during the latter part of July. Copies will be mailed to subscribers who ordered an index for Volume 135. Subscribers who did not order a copy of that index or who have changed their address should return this coupon to

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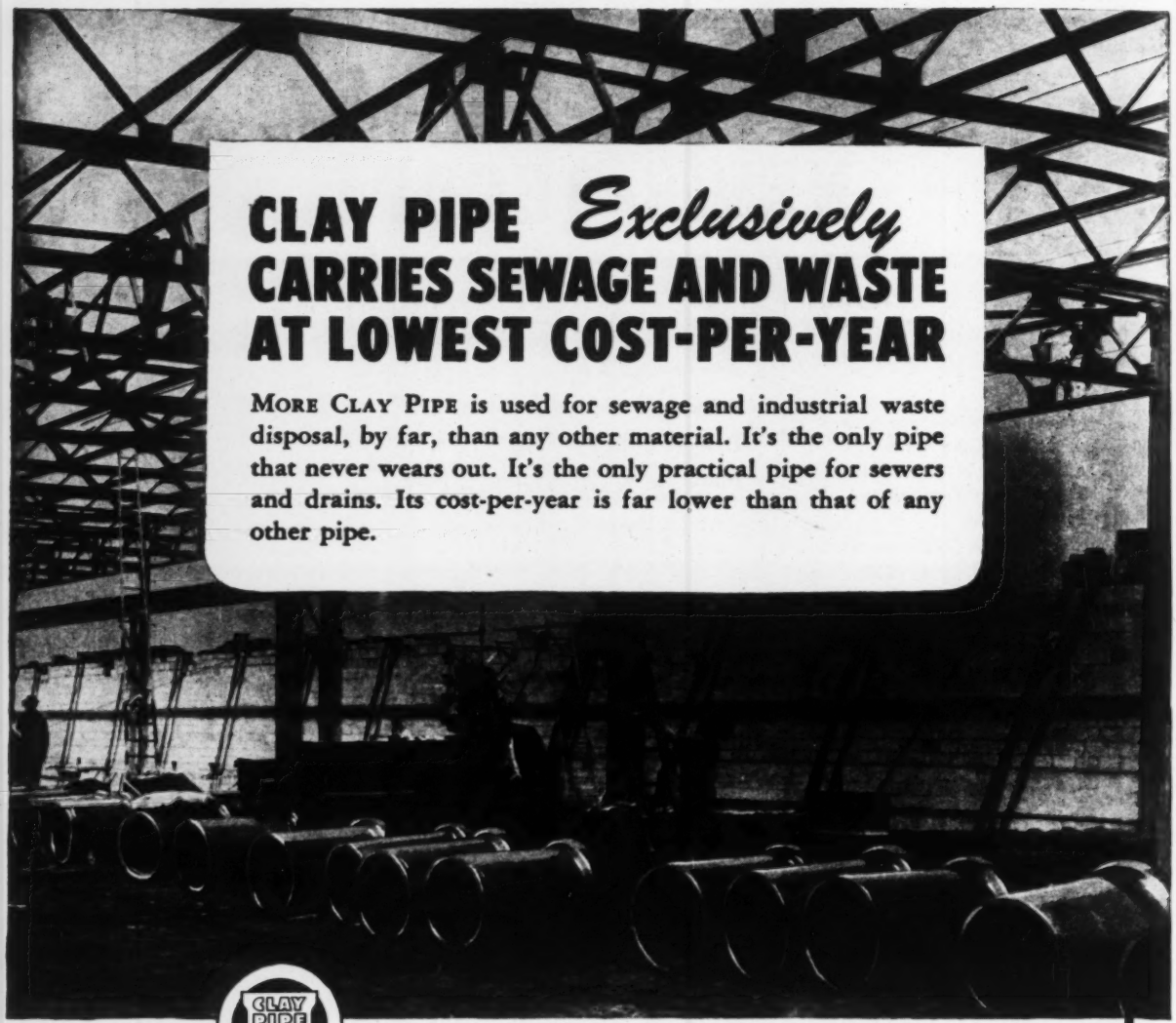

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Construction Trends

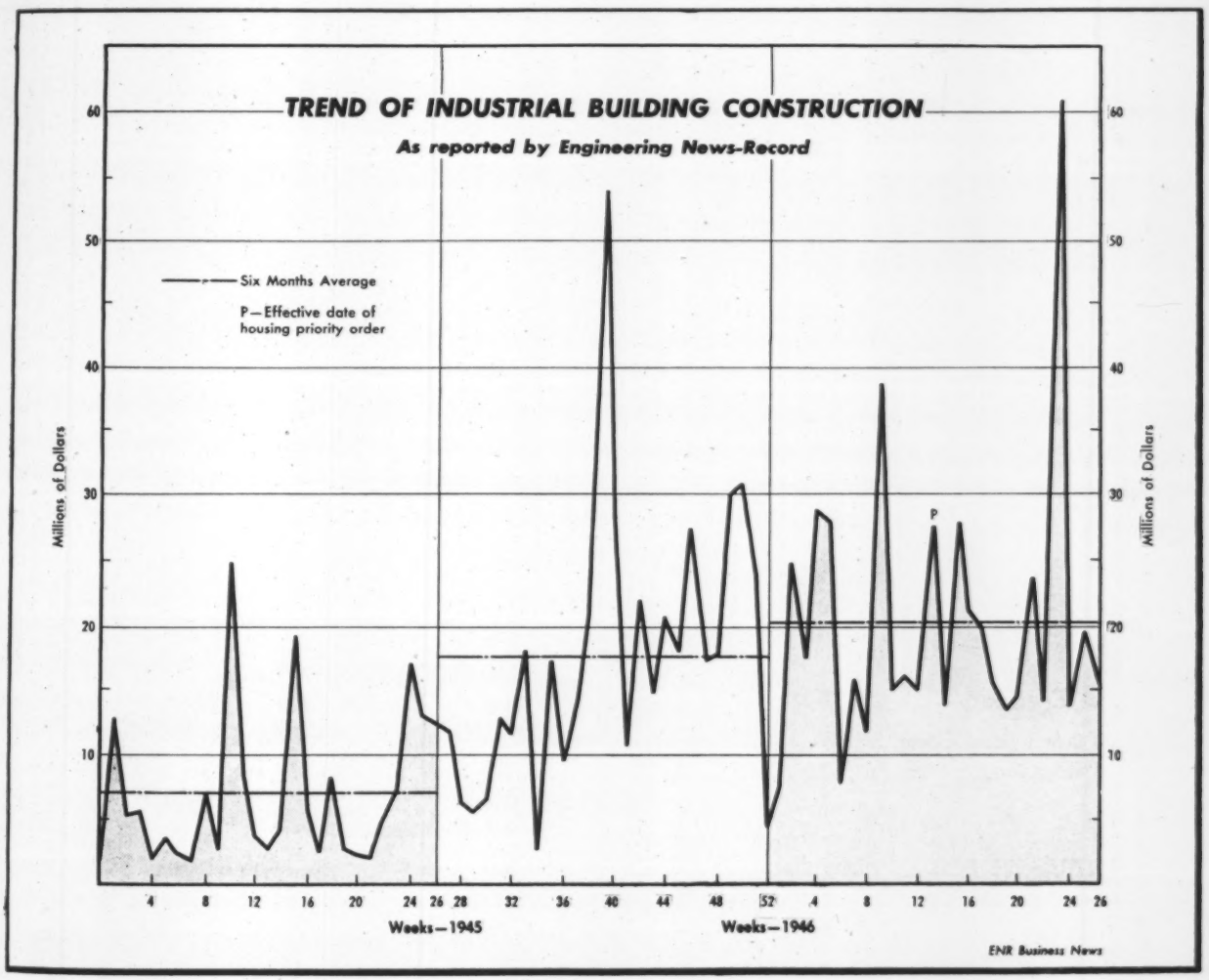
Industrial Building Contracts Headed for Another Record

New contracts totaling $526,915,000 were awarded for industrial buildings during the first six months of 1946 as reported by *Engineering News-Record*. This compares with the 1945 all time record 12-month high of $635,170,000.

The average week for the first half of 1946 is $20,265,000 compared with $17,470,000 during the second half of 1945 and $6,950,000 during the first half.

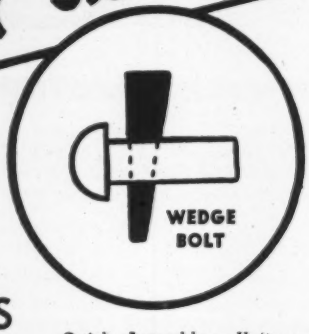
The housing priority order was made effective on March 26 so that only essential building could go ahead. Under it industrial building must be approved in order to proceed. The 1946 weekly average of industrial building contracts preceding this housing priority order was $19,530,000. since the order, the average has been $20,900,000.

These totals are made up of a great many smaller plants rather than a few large ones. Examination of some of the larger plants indicates that they are essential. In the building material group are steel mills, lightweight aggregate plants, glass plants, linoleum plant, aluminum plant, ($30,000,000 total—site preparation and foundations proceeding at this time), gypsum plant. Food plants, packing plants, and farm equipment plants, a plant to build small electric motors and a number of generating or power plants for public utilities and manufacturing plants, chemical plants, plastics plant, chlorine plant, automobile plants, airplane maintenance plant, machine shop, several laboratories, are typical of the larger plants, $500,000 or over. Several large warehouses, for steel, electrical products, at a railway terminal indicate the hopeful expectation that there is going to be something to put in them. The buildings below $500,000 also include a generous sprinkling of warehouses.



Look! NO FINS!

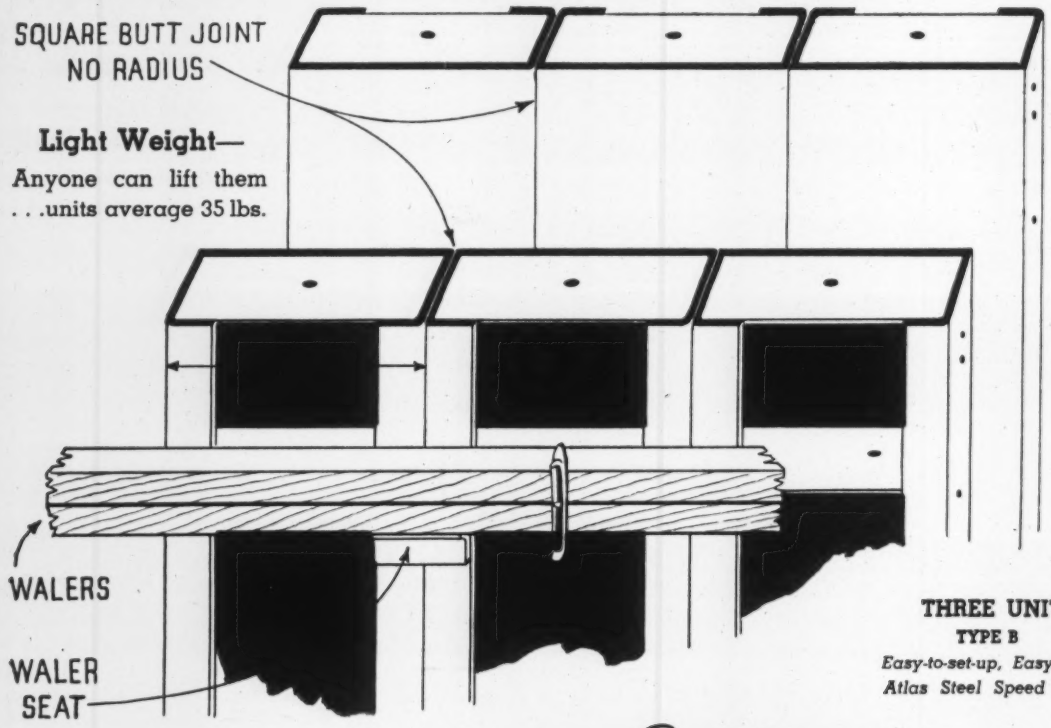
Atlas "Finless" Speed Forms



SMOOTH WALLS AND FLOORS Require No Finishing

Quick Assembly — Units go together with no-thread wedge bolts.

New Process for Concrete Construction



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New Construction Volume in June

June contracts of $555,000,000 bring total for first half to $2,632,000,000, a 200 percent gain over 1945. Private construction up 550 percent.

Civil engineering construction volume in continental United States totals $555,469,000 for June, an average of $138,867,000 per week as reported by *Engineering News-Record*. This is 24 percent above the May average and 190 percent above June, 1945.

Private construction in June is 33 percent higher than last month and 430 percent above last June. Public construction is 11 percent above the May average and 165 percent above last June.

With this June volume, engineering construction rolled up a total of $2,632,186,000 in the first half, 200 percent higher than the first 6 months of 1945 and 15 percent more than in all 12 months of 1945. This is the fastest sustained advance ever recorded for the construction industry.

June averages by classes of construction showed the following gains over May: public buildings, 95 percent; industrial buildings, 70 percent; commercial buildings including housing, 12 percent; public bridges, 12 percent; private bridges, 65 percent; sewerage, 215 percent; earthwork, irrigation and drainage, 3 percent and private unclassified a 217 percent gain. A lower rate of awarding contracts in June compared with May was recorded in highways, 13 percent; waterworks, 22 percent; and public unclassified, 15 percent.

Geographically the South dropped off 4 percent and Far West, 28 percent; while New England gained 19 percent over May; Middle Atlantic, 142 percent; Middle West, 38 percent; and West of Mississippi, 39 percent.

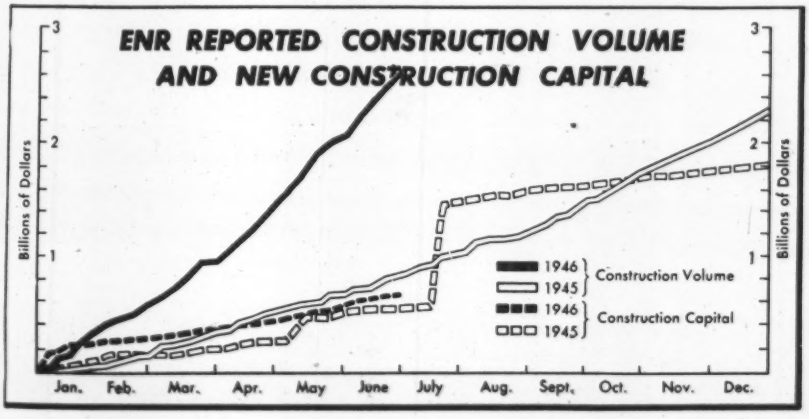
All sections made strong gains over June, 1945: New England, 143 percent; Middle Atlantic, 500 percent; South, 320 percent; Middle West, 29 percent; West of Mississippi, 340 percent; Far West, 74 percent.

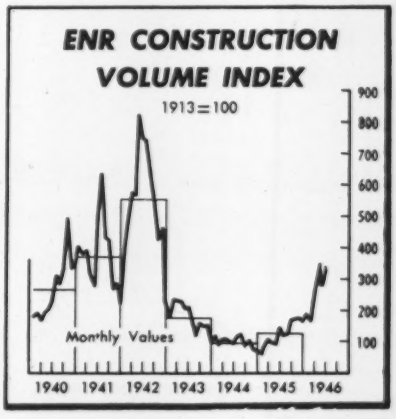
ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD—JUNE, 1946

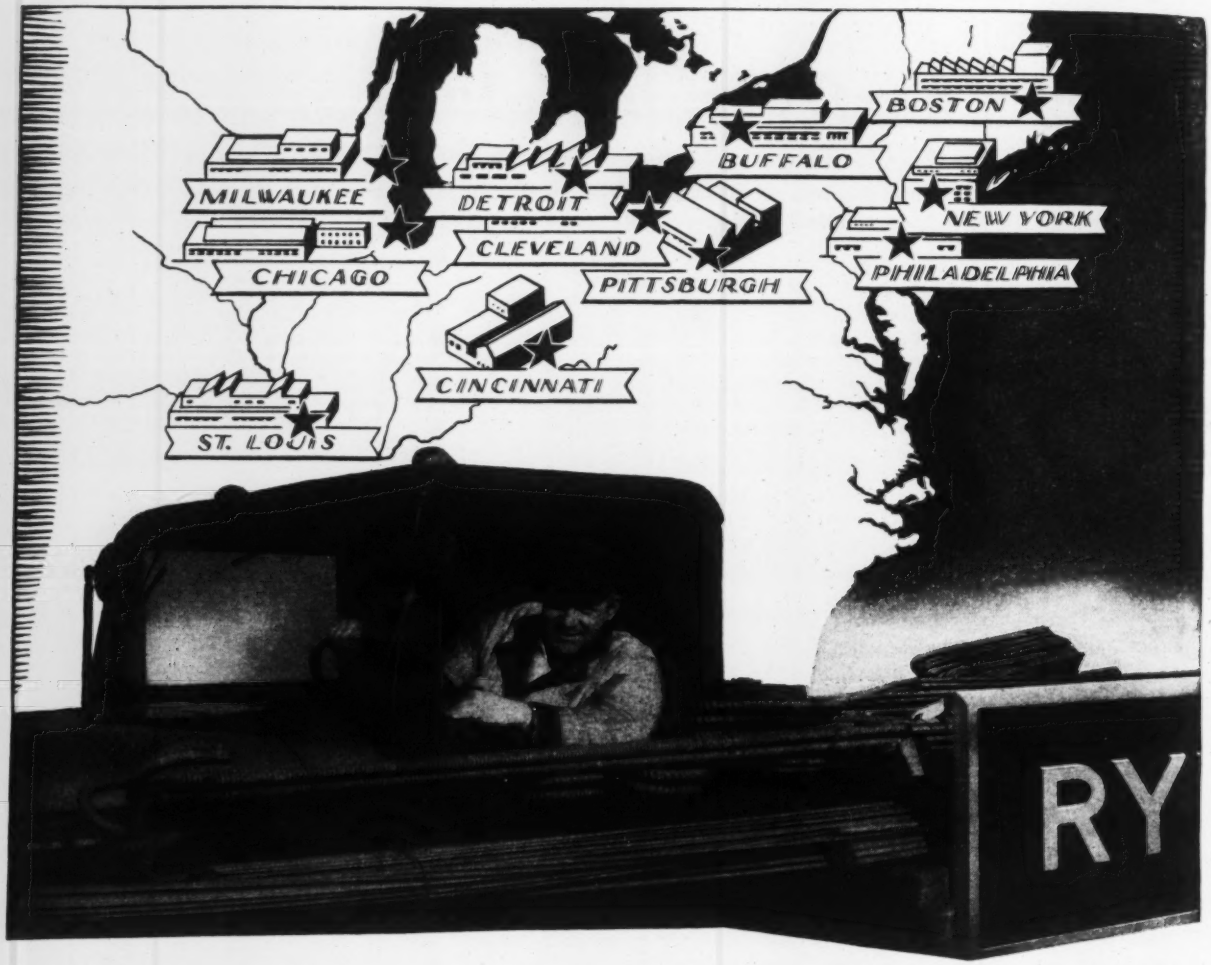
Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs — waterworks, excavation, drainage and irrigation,* $22,500; *other public works,* $40,000; *industrial buildings,* $55,000; *other buildings,* $205,000

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States June 1946	United States Six Months 1946	United States Six Months 1945	Canada
Public Works										
Waterworks	560	157	1,134	949	1,044	1,099	4,943	46,249	19,797	424
Sewerage	746	610	282	6,811	1,050	9,563	19,062	45,880	14,623	410
Bridges, public	1,864	3,607	1,745	1,861	948	3,329	13,354	62,466	9,253	220
Earthwork and waterways	800	6,412	3,967	350	15,769	16,722	44,020	194,714	19,871	37
Streets and roads	3,887	12,875	14,897	16,199	16,558	7,392	71,788	358,836	94,212	4,172
Buildings, public	2,604	5,916	12,911	7,070	7,921	2,834	39,256	162,959	305,727	1,968
Unclassified, public	844	4,548	1,594	1,134	1,514	4,223	13,857	82,343	155,817	40
Total public	11,285	34,125	36,530	34,374	44,804	45,162	206,280	953,447	619,300	7,271
Federal government (included in above classifications)	3,304	12,190	7,129	1,580	19,570	21,159	64,932	313,702	487,306	.....
Private										
Bridges, private	.....	.....	.....	.....	.....	150	150	1,471	3,631	.....
Industrial buildings	9,420	26,423	7,581	11,698	38,664	15,695	109,481	526,915	180,751	6,590
Commercial buildings	5,480	110,747	25,500	9,314	21,211	39,287	211,539	1,042,741	44,290	4,260
Unclassified, private	564	846	2,114	215	12,866	11,414	28,019	107,612	28,183	5,580
Total private	15,464	138,016	35,195	21,227	72,741	66,546	349,189	1,678,739	256,855	16,430
Total Engineering Construction:										
June, 1946 — 4 weeks	26,749	172,141	71,725	55,601	117,545	111,708	555,469	.....	.....	23,701
May, 1946 — 5 weeks	28,057	88,747	93,662	50,525	105,824	193,429	560,244	.....	.....	43,294
June, 1945 — 4 weeks	11,012	28,618	17,080	43,096	26,784	64,024	190,614	.....	.....	11,121
Six Months — 1946	160,048	600,448	340,431	309,340	534,752	687,167	.....	2,632,186	.....	165,539
Six Months — 1945	37,918	120,385	151,823	138,140	198,141	229,748	.....	.....	876,155	56,204







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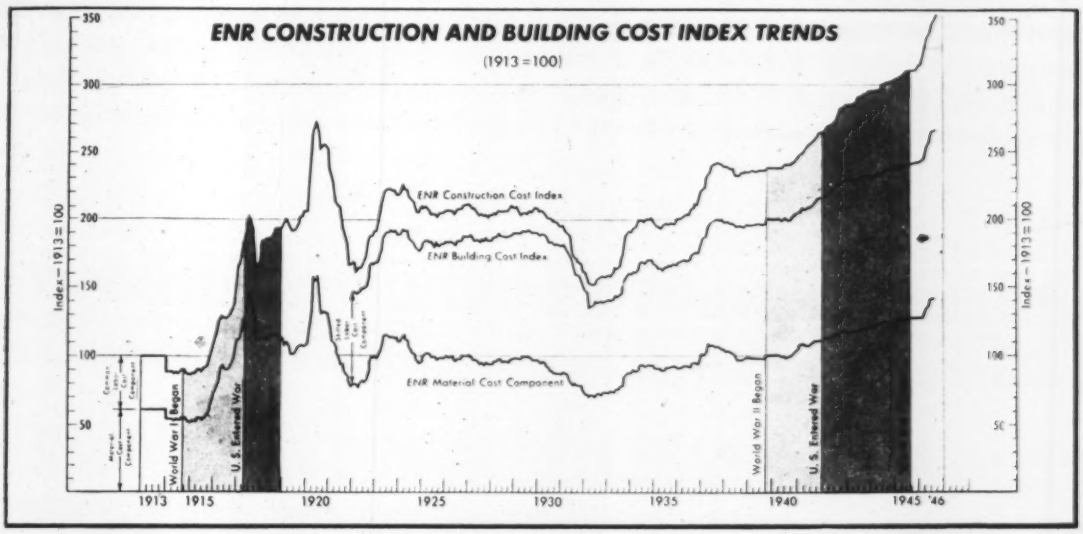
JULY CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	June 1945 (4 wk.)	June 1946 (4 wk.)	% Change	Six Months 1945 (26 wk.)	Six Months 1946 (26 wk.)	% Change
Total U. S. Construction	190,614	555,469	+191	876,155	2,632,186	+200
Private Construction	65,714	349,189	+431	256,855	1,678,739	+554
Public Construction	124,900	206,280	+65	619,300	953,447	+54
Federal	88,317	64,932	−26	487,306	313,702	−36
E N R Construction Volume Index 1913 = 100	133	344	+159	95	264	+178
Total New Productive Capital	28,041	72,919	+160	539,751	667,398	+24
Private Investment	26,341	9,074	−66	266,141	196,391	−26
Federal (non-federal work)	1,700	63,845	+366	22,600	312,687	+784
Federal (federal work)	.....	.....	.....	251,010	158,320	−37

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
July, 1946	353.89	170.11	266.13	143.86	...	...
June, 1946	347.91	167.24	264.16	142.80	344	151
May, 1946	339.69	163.29	257.25	139.06	284	135
April, 1946	334.59	160.83	254.37	137.50	340	149
Mar., 1946	323.83	155.66	245.41	132.66	256	113
Feb., 1946	319.52	153.59	243.94	131.88	167	73
Jan., 1946	316.32	152.05	242.23	130.94	189	83
Dec. 1945	313.48	150.69	240.82	130.18	163	71
Nov., 1945	309.28	148.67	240.55	130.00	173	76
Oct., 1945	309.28	148.67	240.35	129.93	167	73
Sept., 1945	309.28	148.67	240.07	129.77	164	72
Aug., 1945	309.08	148.57	239.94	129.70	119	52
July, 1945	308.99	148.53	239.64	129.54	119	52
June, 1945	308.99	148.53	239.37	129.40	133	58
1945 (Av.)	307.74	147.93	239.14	129.27	123	54
1944 (Av.)	298.63	143.39	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	12 ,.66	176	77
1942 (Av.)	276.31	132.82	222.39	120.22	553	243

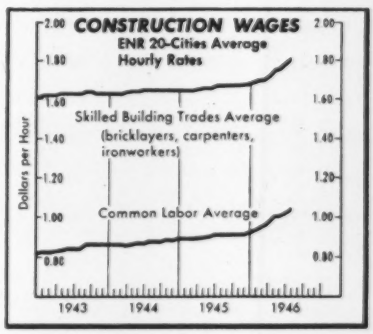
CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICES

1913=100	July 1945	July 1946	% Change	Change June to July 1945 June	1945 July	%	1946 June	1946 July	%
E N R Constr. Cost Index†	308.99	353.89	+14.53	308.99	308.99	.0	347.91	353.89	+1.72
E N R Building Cost Index†	239.64	266.13	+11.05	239.37	239.64	+.11	264.16	266.13	+.75

†*Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$0.916	1.058	+15.50	$0.916	$0.916	0	$1.034	$1.058	+2.31
Skilled Labor (Av. 3 Trades)	1.665	1.811	+8.77	1.661	1.665	+.2	1.798	1.811	+.72
Bricklayers	1.770	1.928	+8.93	1.762	1.770	+.5	1.918	1.928	+.52
Structural Ironworkers	1.716	1.825	+6.35	1.712	1.716	+.2	1.80	1.825	+1.39
Carpenters	1.510	1.688	+11.79	1.510	1.510	0	1.677	1.688	+.66
Cement, per barrel	2.74	2.824	+3.07	2.74	2.74	0	2.774	2.824	+1.80
Reinforcing Steel, cwt.	2.79	3.259	+16.81	2.79	2.79	0	3.19	3.259	+2.16
Structural Steel, base	2.10	2.318	+10.38	2.10	2.10	0	2.318	2.318	0
Sand, per ton	1.24	1.405	+13.31	1.24	1.24	0	1.395	1.405	+.72
Lumber, 2x4 Fir, per M ft.	55.87	67.847	+21.44	55.87	55.87	0	66.515	67.847	+2.00
Lumber, 2x4 Pine, per M ft.	53.44	60.90	+13.96	53.44	53.44	0	60.412	60.90	+.81
Common brick, per M	18.51	21.125	+14.13	18.46	18.51	+.3	21.125	21.125	0
Ready-mixed concrete, c.y.	7.58	8.071	+6.48	7.60	7.58	−.3	7.973	8.071	+1.23
Struct. clay tile, 3x12x12	84.75	94.628	+11.66	84.75	84.75	0	92.316	94.628	+2.50

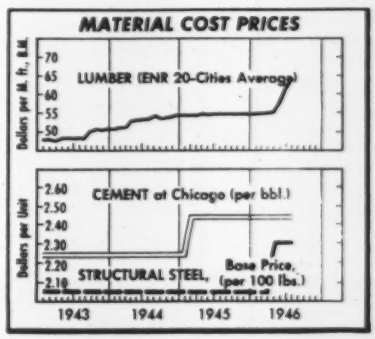


MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	June 1945	June 1946	% Change	May 1946	% Change May to June
Steel (% operating Capacity) A.I.S.I.	90.4	75.7	−16	50.1	+51

	April 1945	April 1946	% Change	Four Months 1945	Four Months 1946	% Change
Cement, thous. bbl. U. S. B. of Mines	7,894	15,369	+95	24,327	43,331	+78

	May 1945	May 1946	% Change	Five Months 1945	Five Months 1946	% Change
Fabricated Structural Steel, tons, A. I. S. C.	54,444	111,686	+105	266,074	498,348	+87
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	75,397	224,259	+197	321,527	1,294,498	+303



COST OF LIVING INDEX . . . EMPLOYMENT

	May 1945	May 1946	% Change	April 1946	% Change April to May
Cost of Living Index, B L S.	128.1	131.5	+2.7	130.9	+0.5
Rent (Housing) Index, B L S.	108.3	108.4	+0.1	108.4	0

	May 1945	May 1946	% Change	April 1946	% Change April to May
Total Employment (est.), thous., B L S.	37,679	37,435	−0.6	36,928	+1.4
Constr. Employment (est.), thous., B L S.	798	1,755	+119.9	1,549	+13.3

Administration Building, McLaughlin Field, Hot Springs, Arkansas. Architects, Erhart, Eichenbaum and Rauch, Little Rock; contractors, Peterson & McFadyen, Little Rock; ready-mixed concrete furnished by C. J. Horner Co., Hot Springs.

FOR THIS HEART OF AN AIRPORT

Better Concrete . . . At No Extra Cost

with Duraplastic Air-Entraining Cement

INTO THIS modern structure went 1,000 cubic yards of ready-mixed concrete made with Atlas Duraplastic. The characteristics of this air-entraining portland cement were reported as follows:

1. **Less water was required to make a workable mix.**
2. **Bleeding and segregation were greatly reduced.**
3. **Less vibration was required for proper placement.**
4. **Surfaces were free from "honeycomb" and sand streaks.**

Atlas Duraplastic cement complies with ASTM specifications. It provides the proper amount of entrained air by intergrinding with the cement the precise amount of air-entraining material needed for satisfactory field performance. It sells at the same price as regular cement. For further information, write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

OFFICES: New York, Chicago, Philadelphia, Boston, Albany, Pittsburgh, Cleveland, Dayton, Minneapolis, Duluth, St. Louis, Kansas City, Des Moines, Birmingham, Waco.

ENR-D-36

ATLAS DURAPLASTIC

TRADE MARK REG. U. A. C. CO.

AIR-ENTRAINING PORTLAND CEMENT

Makes Better Concrete at No Extra Cost

A UNIVERSAL ATLAS PRODUCT

U. S. STEEL RADIO SHOW—*Sunday Evenings—Consult local newspaper for time and station*

News of the Week

ENGINEERING NEWS-RECORD • JULY 11, 1946 • VOLUME 137 • NUMBER 2

New cement specifications approved at ASTM meeting

Revisions made in several specifications for cement—Existing specifications for structural steel plates consolidated—Building construction tests studied

Numerous changes in cement specifications were approved at the latter sessions of annual meeting of the American Society for Testing Materials held in Buffalo, June 24-28. A report of the opening sessions of this meeting was given in the July 4 issue, vol. p. 7.

The ASTM "Standard Specifications for Portland Cement" (C 150-44) were revised to raise the maximum limits for SO_3 contents of types I and III cements from 2.0 and 2.5 percent, respectively to 2.5 and 3.0 percent, respectively, when the C_3A content is greater than 8 percent. Another revision involved insertion of a reference to retesting in cases of local storage.

Tentative Specifications for Air-Entraining Portland Cement (C 175-46T) were modified to delete the words restricting cement for use in pavements; to raise permissible limits on air content of the standard mortar from 14 ± 4 percent to 16 ± 4 percent; and to set the maximum limit for SO_3 content for Type IA cement at 2.5 percent when the C_3A content is greater than 8 percent.

Specifications for Portland Blast-Furnace-Slag Cement (C 205-46T), Method of Test for Fineness of Portland Cement by the Air-Permeability Apparatus (C 204-46T) and Method for Determining Darex Air-Entraining Agent in Portland Cement (to be included as part of C 114-44T) were accepted as tentatives.

Steel specifications revised

Two new specifications affecting structural steel plates were approved at the meeting—one covering carbon-steel plates of structural quality with low and intermediate tensile strengths, 2 in. and under in thickness, the other covering carbon-silicon steel plates with intermediate tensile strengths for machine parts and general construction, over 2 in. thick.

Concurrently, two existing standards have been withdrawn. They are Mild Steel Plates (A 10-39) and Low Tensile Strength Carbon-Steel Plates of Structural Quality for Welding (A 78-43), which have been essentially consolidated in the first of the new specifications. The new specifications cover in one document the three commonly used grades, and this channeling of production is expected to be beneficial to both consumer and producer. The existing workmanship clause has been retained.

Revisions in the commercial bar specifications, hot-rolled (A 107) and cold-finished (A 108) have been made to bring them up to date. They also incorporate, as information, tables of estimated tensile values.

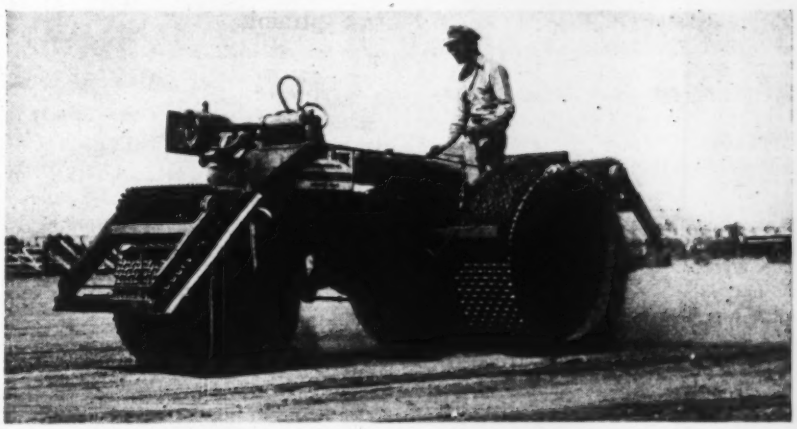
A subcommittee on methods of physical testing is fostering for Committee A-1 on Steel the preparation of its own distinct methods of testing. This may involve new documents covering, for example, methods of tension testing of steel.

Studies of building materials

The newly organized Committee E-6 on Methods of Testing Building Construction has formed subcommittees to study methods of tests on panels for light-building construction, on connections and assembled structures, on large structural units (trusses, girders, arches) and on general structural elements (joists, posts, columns).

Specifications for Structural Insulating Board Made from Vegetable Fibers, Methods of Testing Structural Insulating Board Made from Vegetable Fibers, Method of Test for Sulfonation Index of Road Tars, and Method for Determination of Combustible Properties of Treated Wood by the Fire-Tube Test Method were also approved as tentative. Tentative Method of Test for Fire-Retardant Properties of Wood (C 160-41T), using the crib test, Tentative Specifications for Cut-Back Asphalt (Rapid Curing Type)

(Continued on page 72)



***Grid Roller**—A new type of roller for use in highway and airport paving has a cylindrical grid of 5/8-in. steel bars spaced so that clear openings between measure 1 in. each way. The grid function is not only for compaction but to force down below the surface oversize stones near the top, thus leaving only fine-textured material on the surface proper. The idler wheels riding the grids are to prevent clogging. This is an experimental type; on later models it is proposed to put the idlers inside the wheels where they can exert outward pressure.*

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—*New York State* scheduled traffic origin and destination surveys for *Syracuse, Poughkeepsie* and *Batavia*. . . . *Baltimore, Md.*, created the post of deputy highway engineer, at $5,000 per year. . . . *California* let highway contracts totalling $2,577,000 for work around *San Francisco*. . . . *Illinois* made an additional $5,000,000 available for farm-to-market roads. . . . *Seattle, Wash.*, halted awards of concrete paving contracts because of lack of cement. . . . Since October, *North Carolina* has let contracts totalling $23,240,000, and announced it would call a halt to lettings for a period to permit its highway staff to catch up with the work. . . . Operating with record-breaking receipts since the first of the year, the *Pennsylvania* Turnpike Commission will begin refunding $42,000,000 in outstanding bonds. . . . Since February, *Georgia* has let highway contracts totalling $16,500,000. . . . The *Montana* Highway Commission recently awarded 11 road and bridge contracts for $1,180,000.

Housing—Contract for erection of 800 dwelling units at five *South Carolina* colleges has been awarded to C.M. Guest and Son Construction Co., *Anderson, S. C.*, at $1,500,000. . . . The University of Minnesota bought 30 lots in *Minneapolis* as homesites for faculty members. . . . Welwood Development Corp. will build 115 homes, to cost $1,200,000, at *Chattanooga, Tenn.* . . . A $32,000,000 subdivision to be known as Oak Forest, has been laid out in *Dallas, Tex.*, to contain 5,512 residences on 1,308 acres of land. . . . Construction, Inc., has been formed at *Pittsburgh, Pa.*, to build housing facilities for families with an income of $40 to $60 weekly. . . . Work has been stopped on more than 800 homes in *Seattle, Wash.*, due to materials shortages. . . . The *New York City* housing authority announced tentative site location for the planned $50,000,000, 6,500-apartment Jacob Riis Houses, on the city's lower east side. . . . The first prefabricated home to be approved by *Minneapolis, Minn.*, building inspectors is now being erected.

Sewage disposal—The *Georgia* State Health Department has approved water and sewage projects totalling $6,082,268, and has additional projects under examination totalling $4,017,000. . . . The *Savanna, Ill.*, city council recently passed an ordinance providing for issuance of $285,000 in bonds to finance an extensive sewer program.

General construction—The Virginia Bridge Co. plans a $1,000,000 fabricating plant at *Birmingham, Ala.* . . . National Life Insurance Co. will build a $2,000,000 office building at *Cincinnati, Ohio.* . . . Fulton County commissioner at *Atlanta, Ga.*, considered plans for a $4,000,000 courthouse addition. . . . Canada Dry Ginger Ale, Inc., plans a new bottling plant at *Minneapolis, Minn.* . . . The Weyerhauser Lumber Co. awarded a general contract for $7,000,000 in improvements to its plants at *Longview, Wash.*, to W. J. Park and Sons, of Yakima, Wash.

Miscellany—*Kokomo, Ind.*, must spend $2,500,000 over a five-year period for improvement of its school system. . . . A million-dollar childrens surgical hospital is planned for *Baltimore, Md.* . . . The *Buffalo, N. Y.* Sewer Authority granted a 40-hour week to its employees.

Capt. Bisset named Navy engineer at Portsmouth

Capt. Andrew G. Bisset, CEC, USN, veteran of four years of naval warfare and formerly commander of construction troops in the assault and base sections at Okinawa, has been named public works officer at the Navy's Portsmouth, N. H. base. He took over his new duties after release from service as senior member of the contract board of the Bureau of Yards and Docks.

Capt. Bisset

A civil engineering graduate (1915) of Lafayette College, Captain Bisset entered Naval service in 1917, after working in private engineering practice with the Pennsylvania Railroad and the George A. Fuller Co. During World War I he was on duty at the submarine base at New London, Conn., and subsequently served at various naval establishments, including the U. S. Naval Academy.

He went to the Pacific in 1942 in charge of construction of an advanced naval base and air bases in the New Hebrides Islands; and in February, 1943, was named officer in charge of the Fifth Naval Construction Regiment. Later in that year he became base construction officer in charge of Seabee activities on the Solomons and Admiralty Islands.

L. A. Paddock retires as bridge companies' head

Leon A. Paddock, who since 1931 has directed the structural steel fabricating and erecting work for many of the world's longest bridges and tallest skyscrapers, has retired as president of the American Bridge Co. and the Virginia Bridge Co. Under his direction, American Bridge took part in construction of the San Francisco-Oakland Bay Bridge, Empire State building, Radio City and many other famous structures.

L. A. Paddock

During the war, Mr. Paddock was responsible for the construction and operation of the Navy's LST shipyard at Ambridge, Pa.

Mr. Paddock's retirement ends a career that began 42 years ago in the drafting room of the Canadian Bridge Co., Ltd., at Walkerville, Ont., following his graduation from the University of Michigan. He rose to the presidency of Canadian Bridge in 1924 and held that position until he joined American Bridge as vice-president in 1927. He was elected president of American Bridge in 1931 and Virginia Bridge in 1936.

Succeeding Mr. Paddock as president of the two bridge companies is Frank K. McDanel, who began 42 years ago as a shopman's helper at American Bridge. Austin J. Paddock has been elected to replace Mr. McDanel as vice president in charge of manufacturing operations of American Bridge.

Mr. McDanel started at the company's Ambridge, Pa., plant, and rose through the ranks to become general superintendent of the shops in 1923. He supervised the fabrication of steel for the Empire State Building, Oakland Bay Bridge, and many others.

Calendar of Meetings

NATIONAL

American Society of Civil Engineers. 1946 summer convention, Davenport Hotel, Spokane, Wash., July 17-20.

REGIONAL

Ninth Annual Short Course for water and sewage personnel, Louisiana State University, Baton Rouge, La., July 25-27.

American Shore and Beach Preservation Association, summer meeting. The Breakers, Cedar Point, Ohio, Aug. 13-15.

Forecast new surveying, mapping era as new commerce needs are clarified

New tools and procedures developed during war expected to produce major changes—Surveying and Mapping Congress criticizes teaching methods as antiquated

A new era in American surveying and mapping lies ahead with a large volume of work to be expected for several years, the American Congress on Surveying and Mapping was told at its sixth annual meeting in Washington, D. C., June 28-29. The great progress and the maximum benefit of the new tools and methods available will not be obtained unless the profession makes major adjustments to take advantage of its promising opportunities.

The importance of the surveying and mapping profession and the scope of its postwar task was outlined at the opening session by Admiral L. O. Colbert, director of the U. S. Coast and Geodetic Survey, who said: "From a national point of view, the one single factor that does more to retard our commercial and industrial development is the lack of adequate surveys and maps over large portions of our territory. Militarily this was pointed up soon after Pearl Harbor when the possibility of defensive operations in the continental United States was recognized and we frantically embarked on a program to improve conditions in areas of strategic importance."

The great scope of the topographic mapping program now getting underway in the U. S. is indicated by the following extract from a committee report. "The War Department has approved a 20-yr. program for the mapping of 1,620,000 sq. mi. of territory in the states and Alaska, beginning with the mapping of 61,000 sq. mi. in the states and 20,000 sq. mi. in Alaska during the 1948 fiscal year." It was also reported that Coast and Geodetic Survey, Forest Service, and the Cartographic Section of the Soil Conservation Service are starting large mapping programs.

New tools are described

American manufacturers had on display many of the new surveying instruments and tools now available. Exhibited by the Engineer Board, U. S. Army Engineers, was the latest American military equipment plus much foreign equipment captured during the war, including several units of which there is no American counterpart.

Other speakers described the more outstanding of the new electronic procedures originally developed for marine navigation and mapping but considered as offering great possibilities for land surveying and mapping.

Extensive postwar use for vinylite, which is one of the most important recent new materials used in cartography and map reproduction, was predicted by G. B. Littlepage of the Coast and Geodetic Survey. This flexible transparent product was described as having high dimensional stability under extreme ranges of humidity, excellent drafting characteristics, and major advantages over tracing cloth and tracing paper for map work.

Better methods on road work

Increased attention on highway projects to obtain the best surveying procedures and thus better layouts was predicted by R. Getty Browning, chief location engineer, North Carolina State Highway Commission. Many mistakes of the past in locating highways, Mr. Browning declared, could have been avoided by the improved surveying and planning procedures now available. Wilson T. Ballard, chief engineer of the Maryland State Roads Commission, said that "today complete and sufficiently accurate detailed topographical surveys are being made of areas a mile or more in width, and of any desired length, in a small fraction of the time, and at far less cost than would be required to obtain the same by old ground methods. Maps to convenient scale, 1 in. to 200 ft., or 1 in. to 100 ft., if desired, with 5-ft. contour intervals, and showing all existing roads, buildings and other man-made features, are produced rapidly in the office, and upon which a final location can be projected with confidence and thereafter staked out in the field to control construction. A comparatively small amount of surveying in the field to establish control points and elevations is necessary, and this can be quickly done."

The procedure used in preparing large-scale photographic base maps of the Philadelphia metropolitan area and Wilmington County, Del., with aerial cameras of long focal length was outlined by Virgil Kauffman, of Aero Service Corp., Philadelphia, Pa. Topographic maps made in this manner to a scale of 1 in. equals 200 ft. and with 5 ft. contours are now being used in New York, Connecticut and Massachusetts for locations for highways in both rural and urban areas, and the Baltimore & Ohio and Reading railroads are using similar maps on relocation work.

Major problems to be solved

Despite the advantages of the new methods and equipment available, the surveying and mapping profession must make many changes before maximum benefit will result, several speakers declared. Murray Y. Poling of the Coast and Geodetic Survey stated that too much work is done without an overall plan as to how a given map or survey can be

(*Continued on p.* 73)

Provide $48 million for Philippine work

A total appropriation of $47,918,000 for rehabilitation work in the Philippines is provided in an urgent deficiency bill (H.R. 6885) already passed by the House and now awaiting Senate approval.

Some $12,000,000 of the money is expected to be spent by the U. S. Federal Works Agency on construction of highways, over $12,000,000 on construction of port and harbor facilities, $8,000,000 for the Civil Aeronautics Administration for building airfields and facilities for an interisland navigation system, and $2,613,000 by the U. S. Public Health Service for health facilities, and $1,092,000 by the U. S. Weather Bureau.

The bill also contains $2,500,000 for the Army Engineers to restore a breakwater at Hilo, Hawaii, and $1,500,000 for the Corps for flood control protection at Louisville, Ky.

Yards and Docks gets $200 million appropriation

An appropriation of $70,966,300 for construction by the Bureau of Yards and Docks within the United States, and $132,260,000 for maintenance, repair and construction work outside the country is provided in the Navy appropriation bill (H.R. 6496) for the fiscal year 1947 now awaiting the president's signature.

Both appropriations are lump sum funds to be spent at the discretion of the Secretary of the Navy. Hearings on the bill indicated that about $8,000,000 will be spent for housing in this country, nearly $36,000,000 for housing outside the U. S., about $4,000,000 for putting up 17 inactivated floating drydocks in this country, approximately the same amount on construction on the mainland to accommodate inactivated ships, and in the neighborhood of $13,000,000 for maintenance operations at overseas bases.

ASTM considers new standards for cement

(Continued from page 69)

(D 597-40T) and Medium Curing Type (D 598-40T) were adopted as standard.

Stripping of aggregates

The general relationship between, and effect of, anti-stripping admixtures upon the wetting power, adhesion and stability of bituminous mixtures in the presence of water were discussed by John C. Sprague, engineer in charge, Division Materials Testing Laboratory, South Atlantic Division, Corps of Engineers, U. S. Army, Atlanta, Ga. None of nine admixtures tested could be said to have an over-all efficiency and none would promote wetting power of asphalt (AC-8) when used in amounts optimum for stability and stripping resistance for coating surface-wet aggregates; nor would any of them sufficiently promote the wetting power of any of the bitumens tested when mixed with the surface-wet, porous lime rocks. On the other hand, practically all of the admixtures were quite effective with the surface-dry aggregates.

G. L. Oliensis, director of research, Lloyd A. Fry Roofing Co., Madison, Ill., in a paper, "Ten Years' Outdoor Exposure of Filled Asphalt Coatings on Saturated Felts," reported that his tests indicate that fillers stabilize the flow and thereby improve the life of roofing cements of relatively low softening point, which have a tendency to flow or sag when unfilled; but fillers do not seem to improve the crack resistance of coatings of higher softening point that do not flow when unfilled.

To overcome the confusion caused by the present multiplicity of tests for bituminous stabilized soils, a method of test for evaluating soil bituminous mixtures has been developed, according to a report by E. O. Rhodes and P. F. Phelan, chairman and secretary, respectively, of the Bituminous Producers' Cooperative Research Committee.

Fatigue of wood

Results of tests reported by W. C. Lewis of the Forest Products Laboratory, Forest Service, U. S. Dept. of Agriculture, on "Fatigue of Wood and Glued Wood Products", indicate that the endurance limit (the maximum stress that can be repeated indefinitely without failure) is not found in tests up to 50 million cycles in cantilever bending, or up to 30 million cycles in direct stress. Consequently, fatigue test results are discussed in terms of endurance loads for a specified number of cycles. In all instances, failures were exactly the same in appearance as those from static loading.

The consensus of the symposium on atmosphere weathering of corrosion resistant steels was that there was a progressive improvement in resistance to atmospheric corrosion with increasing chromium content—at least up to 18 percent chromium. Increasing the nickel content about 8 percent did not appreciably improve resistance. Of special interest was a report by H. A. Grove, of the Central Alloy District, Republic Steel Corp., Massilon, Ohio, on the findings of the committee that inspected architectural installations on skyscrapers in New York and Philadelphia, on building fronts along the Boardwalk at Atlantic City, N. J., and on a steel train. Most installations were found in excellent condition, the report concluded.

Congress approves more planning funds for FWA

A total of $35,000,000—in addition to more than $30,000,000 previously appropriated—was added to the funds available to the Federal Works Agency for assistance of state planning bodies, by recent Congressional action.

The money, to be apportioned to the states according to population, is to be handled by the Bureau of Community Facilities of the FWA.

Garrison Dam District for Army Engineers

Lt. Gen. R. A. Wheeler, Army Chief of Engineers, June 28 announced creation of a Garrison Dam engineer district in the Missouri River Division to take over construction of Garrison Dam in the main stream of the river (ENR June 13, vol. p. 920). Col. W. W. Wanamaker will be district engineer, establishing headquarters for the new district at Ft. Lincoln, N. D.

Portland Cement Assn. to expand its research

The Portland Cement Association, through its president, Frank T. Sheets, has announced plans for an immediate expansion of its research and development in the field of portland cement, concrete and their engineering applications.

The association's member companies have set aside a substantial part of their yearly income to be used solely for this work.

All such activities will be handled through a newly created division of research and development, to be administered by a vice president who will be responsible only to the president. The association has announced the election of A. Allan Bates, formerly associated with research activities of the Westinghouse Electric Corp., to this post.

Wide World photo

New York to Replace Fire-Wrecked Ferry Terminal—A new $12,000,000 ferry terminal will be built by New York City to replace a 30-year-old structure ruined in a major fire at St. George, Staten Island, June 25-26. The blaze, tentatively attributed to sparks from electric rapid-transit trains serving the terminal, caused damage estimated at over $2,000,000, and complicated transit for some 35,000 commuters. Plans for a new terminal were under way before the fire, and are now being completed. City officials proposed expenditure of $3,000,000 on replacement during the remainder of this year.

Bikini atom bomb test stresses science rather than spectacular effects

Dispatch from P. W. Swain, editor of Power magazine and one of McGraw-Hill Publishing Company's observers at the atom bomb tests in the Pacific.

This story starts at 9 A.M. Monday, July 1, Bikini time. The world's fourth atomic bomb has exploded a few hundred feet above a target array of 73 ships anchored at the east end of Bikini lagoon in the Marshall Islands, about 2,000 miles west and somewhat south of Hawaii.

The bomb was dropped by an Army Air Force B-29 about six miles up. It exploded over a spot about three miles south of Bikini Island.

From my stand on the sky deck of the press ship *Appalachian*, about twenty land miles from the burst, the vast target fleet lay hidden below the horizon. First through welder's goggles, and then with uncovered eyes, I saw the initial rapidly-expanding ball of fire and the rising of the great golden mushroom which ascended to a height of five miles in a few minutes, and ultimately up to seven miles.

The cloud was beautiful and impressive but many daily press men found less drama than they had expected in the initial bright flash and in the modest boom that reached their ears about 100 seconds after the flash. They forget that even the greatest things can be dwarfed by distance. At five miles exactly the same bomb burst could have been described as awe-inspiring without any exaggeration.

Headed by Admiral Blandy, Army-Navy Joint Task Force 1 had marshalled 42,000 men for this unique "Operation Crossroads" by midnight last night (Saturday, June 30, here). The last technician and all of the 169 support ships were out of the lagoon. The bomb fell as close as one could reasonably expect from 30,000 ft.—apparently quite effectively, sinking five ships, severely damaging six more, and slightly damaging half of the rest.

Despite many forewarnings that this was a laboratory setup, not a simulated attack against a fleet normally arranged in a harbor, news men were tempted to play up a strictly technical operation as a sort of glorified bowling match with the navy ships as the pins. By itself, of course, the number of ships sunk or damaged means nothing, for results can be varied by spreading the ships or bringing them closer together. Despite much gossip to the contrary, I think it obvious that this first test (test "Able") was reasonably well designed to carry out the Presidential directive that graded damage, from great to slight, should be obtained.

The true aim of these tests was to secure a set of data in curves, rather than a box score—curves correlating pressure, temperature and damage to every ship and every part and every piece of equipment, with the distance from the bomb. It may be hard to make the American public understand how vital is such information. Without it naval designers cannot build ships or bases suited to an atomic age.

Important data expected

The independent scientists on our sister ship, the Panamint, tell me that they expect valuable information in the field of pure science, particularly in radiation from high temperature sources, in oceangraphy and radioactivity, biology and botany. However, the big bosses of Operation Crossroads justify their experiment strictly as a source of essential military information. The general scientific data will be an important by-product. The public interest is well represented at the Cross roads by the President's Evaluation Commission headed by Karl T. Compton, President of M.I.T., as well as by the scientific observers on the Panamint.

I have seen no evidence that the test is "rigged" in any important respect to make an unfair showing for the Navy, but such charges and suspicions will inevitably arise. The public will have special need for the advice of competent and disinterested observers. Even with such advice there is danger that Crossroads may become one of the most persistently misinterpreted technical experiments in history. As this is written, late on July 1, Bikini time, our ship is parked at the lagoon entrance, waiting for word from the radiologists that we may enter to study target ship damage at close range.

Surveying, mapping group elects heads

(*Continued from page* 71)

made part of a comprehensive program.

S. A. Bauer, a surveyor of Cleveland, Ohio, and chairman of the property surveys division of the congress, declared that surveyors in private practice have failed to keep their methods of operations sufficiently up to date in the past 20 years. He said that their immediate task is that of educating themselves and then the public to their own importance and value.

The failure of surveyors to give sufficient attention to the legal and broad aspects of their work was stressed by William C. Wattles of the Title Insurance and Trust Co. of Los Angeles. He said, "In the location of boundaries it is essential to understand the laws governing ownership of land, transfer of titles thereof, legal interpretations of the nature of such boundaries and the language in conveyances defining the same. It is also necessary to understand the specific identities or differences between physical positions and record positions."

Colleges criticized

Engineering colleges were severely criticized by George H. Harding, research professor of civil engineering at the Ohio Engineering Experiment Station, for failing to provide adequate courses in the use of modern surveying methods and equipment. His remarks brought forth much discussion, including considerable favorable comment.

Prof. Harding proclaimed, "There is no corresponding example in the entire field of engineering education where actual practice has so far outstripped the instructional phase as in the case of modern mapping with its attendant control surveys."

Distribution of available data

Failure of the federal agencies to increase their own efficiency as well as that of individuals, commercial firms and local governmental agencies through the establishment of a central agency for distribution of all the federal government data and maps was scored by Capt. Frank S. Borden, Chief, division of charts, Coast and Geodetic Survey. Capt. Borden recommended the establishment of an inter-departmental committee on surveying and mapping composed of one member designated by each of the departments of Agriculture, Commerce, Interior, War and Navy.

The U. S. Geological Survey has already organized and streamlined its map information office to better aid the public as part of a greatly expanding mapping program, according to C. F. Fuechel of that agency.

Joseph M. Dearborn, director of the Bridgeport, Conn., Geodetic Survey, made an appeal for a similar centralized survey and map agency in city governments.

Capt. Borden was re-elected president for the coming vear. A. L. Shalowitz of the U. S. Coast and Geodetic Survey will continue as editor of the congress's publication "Surveying and Mapping".

Winds beyond design assumptions wrecked Navy's timber hangars

Naval court inquiry into hurricane damage at Richmond, Fla., brings out no inadequacies in design, which was a war expedient made on a "calculated risk" basis, according to testimony presented

Neither the design nor the material were at fault when hurricane and fire destroyed three huge timber blimp hangars at the Navy's Richmond, Florida, Naval air station last September (*ENR* Sept. 20, 1945, vol. p. 353) according to a statement of the Navy's Bureau f Yards and Docks made after investigation by a Naval Court established the fact that the hangars more than withstood the wind velocities for which they were designed.

The three hangars were among the world's largest timber structures, being 171 ft. high, (154 ft. clear height) 1,058 ft. long and having a clear inside span of 237 ft. Catenary arch-shaped structures, each containing some 3,000,000 b.ft. of timber, the hangars were erected during 1942 (*ENR* Oct. 14, 1942, vol. p. 576). They failed under wind velocities estimated by the Naval investigators at more than 160 mph., and in crashing to the concrete floor, started fires which destroyed blimps and airplanes stored there to escape hurricane damage.

According to the Naval court's report, Bureau of Yards and Docks designers said that the hangars were designed to resist 110-mph. winds. The design was characterized as a "calculated risk" taken for the sake of speed in construction and the need to conserve steel during wartime. Although the building code for Miami area calls for a 120 mph. velocity to be used in design, the "calculated risk" was based on the probable incidence of storms greater than 110 mph. as calculated by the U. S. Weather Bureau at Miami.

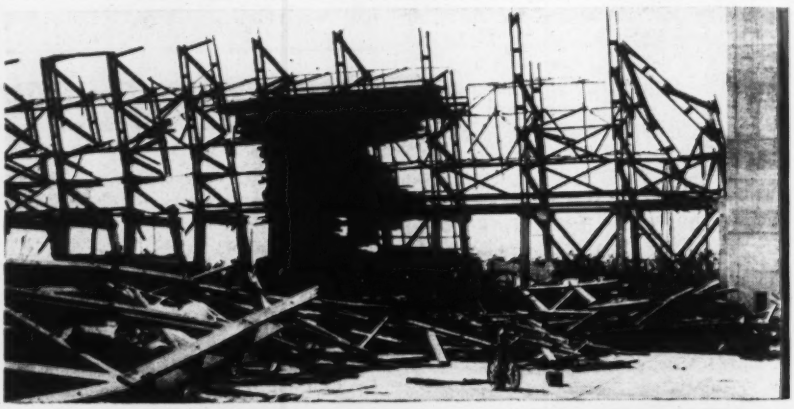
According to the Bureau of Yards and Docks statement, investigators estimated that maximum gust velocity on the hangars at the peak of the storm reached 160 mph. and advanced the theory that a tornado, superimposed on the hurricane, also occurred in the hangar area. Under such loads the hangars failed simultaneously from general overstress rather than in any particular phase of the framing. The first apparent damage in hangar 1 occurred in the skylights on the leeward side, which had been left open for equalization of pressure. The roof of hangar 2 collapsed when the southeast corner gave way in two sections, immediately followed by the entire southeast half of the structure; thereafter the northwest section remained intact for perhaps five minutes before collapsing. Louvre vents along the crown of hangar 3 were first completely ripped off, immediately following which the entire structure collapsed.

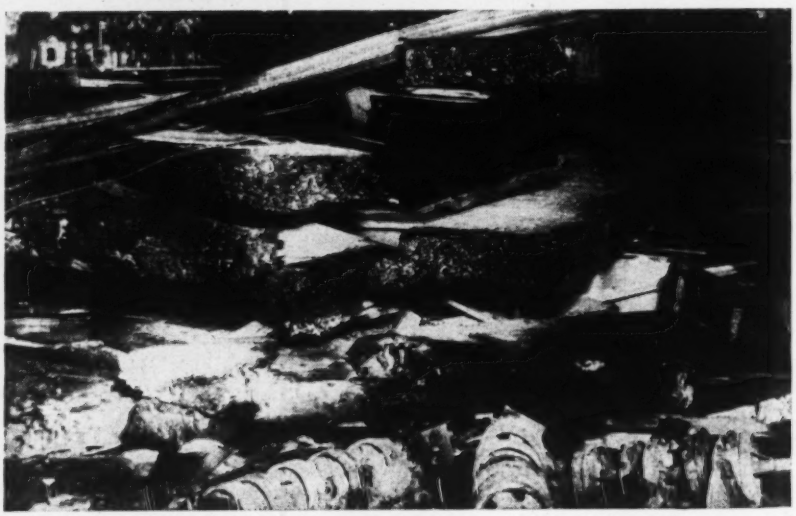
Reinforced concrete bents on which the timber arches rested were left standing but were damaged by the fire. Timber arch ribs collapsed, except that in all the hangars a few ribs, including the purlins, rafters, sheathing, and bracing were still in place up to about the third or fourth panel point from the bottom. Some timber joints were completely torn apart, although the bolts of those joints were tight and connectors were sound; maintenance had been adequate, and there was no evidence of rot.

The fire, which broke out after the structural collapse, probably resulted from electrical short circuits of the station power system, from stored aircraft battery assemblies or from sparks caused by the falling metal striking concrete. Any of these, the statement continues, would have ignited the high-octane gasoline that escaped from the ruptured tanks of the stored aircraft. Resultant temperatures perhaps as high as 2,000 F. were attested by fused glass, melted copper and reduction of metal parts.

The effect of chemical treatment of the timber in retarding the fire made it seem plausible that, without collapse, there would have been no fire.

Failure could not be laid to the structural performance of the material. Wind forces at the time of collapse were about two and one-half times those for which the structures were designed.





***Fire, Hurricane Damage**—Typical hangar wreckage, where fire was not directly fed by gasoline, shows timber arches broken about four panels up from concrete bent supports. Fire-retardant wood resisted all but direct gasoline flames and did not itself support combustion nor spread of the fire.*

Interior bill provides for much construction

Reclamation receives $108,000,000, national parks over $18,0000,000 and Bonneville Power Administration $8,470,000.

Before sending the Interior Department Appropriation Bill (H.R. 6335) for the next fiscal year to the White House for the President's signature, Congress agreed upon a total of $158,199,508 for engineering and construction work. This amount is a compromise between the $107,345,530 total and the $169,117,270 amount agreed upon previously by the House and Senate respectively (*ENR* June 27, vol. p. 963).

The Bureau of Reclamation was supplied with the largest amount. It receives $108,563,898, which is earmarked as shown in the accompanying table. In addition to the money in the table the bureau receives several small appropriations for operation and maintenance, some of which will call for limited amounts of construction.

The National Park Service is provided with $18,330,000 which will be spent as follows: $11,000,000 for construction of parkways, $1,330,000 for parkway improvements, and $6,000,000 for roads and trails.

An amount of $8,470,000 is earmarked for the Bonneville Power Administration for construction of transmission lines, substations and appurtenant facilities. Also provided in the bill is a $4,000,000 item for operation and maintenance at Bonneville.

The Bureau of Indian Affairs receives a total of $7,647,838 which is broken down as follows: $3,700,000 for construction of roads; $3,023,800 for construction of buildings; and $924,038 for construction of irrigation systems.

The Southwestern Power Administration is appropriated $7,000,500 for construction of transmission lines, substations and appurtenant facilities.

A total of $5,498,672 is provided for the Geological Survey, consisting of $3,000,000 for topographic surveys and $2,498,672 for gaging streams.

The Territory of Alaska has an amount of $2,189,100.

Special Fund, Reclamation Fund and General Investitions	$5,000,000
Construction:	
San Luis, Colo.	650,410
Boise, Idaho, Payette Division	2,782,659
Boise, Idaho, Anderson Ranch	1,234,475
Minidoka, Idaho	1,000,000
Palisades, Idaho	650,410
Rio Grande, N. Mex.	360,675
Tucumcari, N. Mex.	1,738,000
Lugert-Altus, Okla.	2,664,610
Deschutes, Ore.	1,716,887
Klamath, Ore.	1,281,605
Provo River, Utah	1,345,040
Yakima, Wash., Roza Division	2,597,100
Kendrick, Wyo.	1,895,000
Riverton, Wyo.	3,520,550
Shoshone, Wyo., Heart Mountain	1,917,672
Shoshone, Wyo., Williwood	196,895
Total Construction	25,780,563
General Construction Fund:	
Gila, Ariz.	2,000,000
Davis Dam, Ariz.	7,500,000
Central Valley	12,685,622
Colorado-Big Thompson Colo.	7,504,075
Hungry Horse, Mont.	867,210
Columbia Basin, Wash.	18,000,000
Total Genl. Const. Fund	48,725,307
Fort Peck	932,893
Missouri River Basin	17,500,000
Colorado River Dam Fund:	
Boulder Canyon—Operation and Maintenance	1,251,530
Boulder Canyon—Construction	433,605
All-American Canal	5,000,000
Colorado River Development Fund	500,000
Water Conservation	3,340,000
Grand Total	113,610,803

In addition to above figures, several small appropriations for operation and maintenance are provided.

AGC governors oppose further price controls

The Associated General Contractors of America, through its governing and advisory board which met in Denver, Colo., last week expressed its belief that the effect of the demise of the OPA is anti-inflationary and will help stabilize all industry, particularly construction, by permitting the production of materials at fair prices.

The delegates opposed the restoration of any type of rate and price control, and asked also for the elimination, as soon as possible, of all other war-created regulations that interfere with the return of free American development. They pledged all their efforts toward preventing increases in construction costs and to stabilize them at an equitable level.

They also warned all contractors against any hasty temporary action on construction prices because of the danger of such action becoming permanent.

Sewage treatment plants for 10 Indiana cities

Final plans for sewage treatment projects in ten Indiana cities and preliminary plans for projects in five others and in two institutions were approved June 20 by the state Stream Pollution Control Board.

The total estimated cost of the projects is $5,000,000. The largest on the list is Elkhart's proposed $3,000,000 system, for which preliminary plans were approved.

Pennsylvania, Virginia push pollution control

Governor Edward Martin of Pennsylvania has ordered the State Water and Power Resources Board to proceed as rapidly as possible with Schuylkill River reclamation projects.

The governor called in Secretary of Forests and Waters James A. Kell, who is also chairman of the agency designated to carry out the restoration job, and directed him to speed up the program.

Martin acted, it was disclosed, after earlier conferences with Attorney General James H. Duff, who has led the administration's anti-pollution campaign.

The state is about ready to begin actual construction of two desilting basins in the upper Schuylkill and to start dredging operations at Black Rock Dam, above Phoenixville.

Virginia also acts

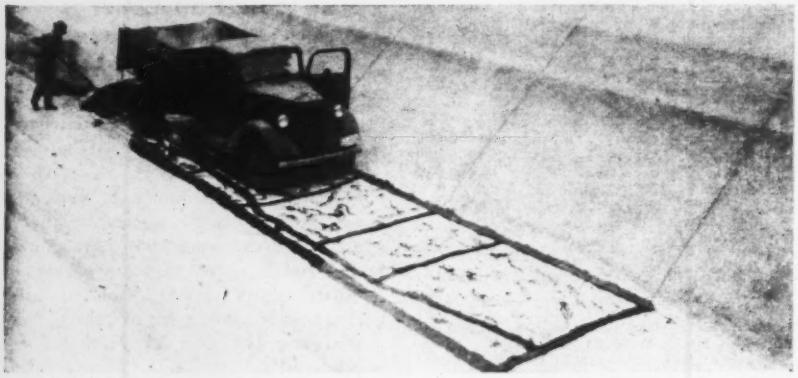
Funds will be adequate for carrying on the work of Virginia's newly-created state water control board, according to Governor William M. Tuck, who has just appointed a 5-member body, which is to have the use of $92,000 for sanitary engineering and industrial hygiene work. Members of the board are to consider means for reducing pollution in industrial areas and other sections of the state.

Contractors penalized for wage overpayments

The construction industry is accounting for 80 percent of the cases regarding wage violations now coming before the National Wage Stabilization Board for prosecution. From Feb. 8 to June 6, more than 6,300 cases involving builders came before the board, which disposed of 1,630 in that period. The cases continue to be received at a rate of over 500 weekly.

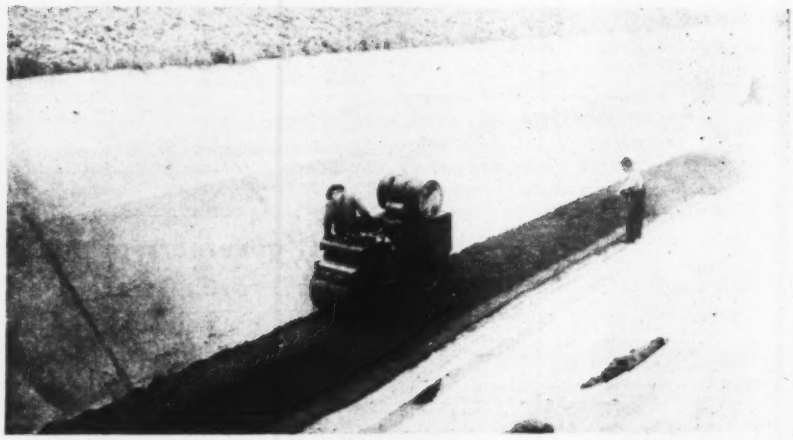
The greater portion of the cases deal with payment of wages above the legal rates set by the Wage Adjustment Board for the various localities in the U. S. Contractors found paying above the legal rates are being prosecuted by not only being prohibited from deducting the overpayments as labor costs in computing income tax statements, but they are also not allowed to include any of the labor cost. For example, a contractor who has paid a carpenter $2 per hour when the legal rate is $1.50 is not allowed to deduct the entire $2 as a deductible expense in operating his project. Contractors are urged by the NWSB to contact the Wage Adjustment Board, Washington, D. C. for the latest legal rates.

Repair lining of Roza irrigation canal



After four years of operation, portions of the 103-mi. Roza Canal—a section of the $40,000,000 Yakima Irrigation Project near Yakima, Wash. are being relined and repaired.

The accompanying photographs, released by the Bureau of Reclamation, show some of the methods being used to put the canal in first class operating condition.



This section of the Roza main canal is being prepared for application of asphalt paving mix (shown below). Cracks are filled and tar bonding strips are applied to concrete surface before spreading hot asphalt and gravel plant-mix paving material, finished with a light road-roller.

Side-slopes of the main canal are made water tight by spraying them with hot aspalt. The asphalt heating unit and pump are at lower right.

Worker makes use of a job-made, air-operated caulking gun, forcing mastic into cracks in the concrete lining. Mastic is mixed in 20-lb. batches, and this pneumatic gun makes possible the placing of a batch in 15 to 30 minutes. A hand-gun took four hours for the same amount of material.

OBITUARY

Lawrence B. Bennett, 46, died June 11 in Dayton, Ohio. He was an engineer in the Franklin County engineer's office for five years, and before that was with the Ohio Highway Department for four years. He was graduated from Ohio State University college of engineering.

Russell K. Annis, 50, former chief engineer for the Fairbanks-Morse Co. and a consulting hydraulic engineer, died June 11 in Columbus, Ohio.

John Barclay Fisken, 84, retired consulting engineer for the Washington Water Power Co. of Spokane, Wash, died in that city June 6.

Joseph Lee Wicker, 84, formerly a civil engineer with the Pennsylvania Railroad and the Panama Railroad and assistant city engineer of Baltimore, Md., died at Oakmont, Pa., June 22.

Paul W. Moore, 54, construction engineer, died at Sanford, Fla., June 21.

Maj. John F. Druar, formerly a member of Druar & Milinowski, consulting engineers, St. Paul, Minn., doing municipal work, died July 3. Major Druar was a veteran of World War I.

George William Borden, U. S. Army Engineer in charge of airport pavement design in the Sacramento District and former Nevada state highway engineer, died June 11 in Sacramento. He had worked for the National Park Service on road construction and related problems between 1933 and 1941. Other professional experience had taken him to South America.

Michael J. Hanick, 63, a civil engineer, who worked on construction of the Hanford, Wash., atomic bomb plant, died July 4 in St. Louis, Mo. He was a former road engineer for the Missouri State Highway Department. He also constructed game refuges for the Biological Survey in Arkansas and Missouri. At various times he engaged in the stone quarry business in St. Louis.

Daniel B. Luten, 76, engineer and former professor at Purdue University, died July 3. Formerly president of the Luten Engineering Co., a bridge-building concern, Mr. Luten had lived in Indianapolis since 1901. He was one-time president of the National Concrete Co. A graduate of the University of Michigan, Mr. Luten was an instructor in the engineering department at Purdue from 1895 until 1900, and in the late twenties served on the Indiana state board of professional engineers.

Clarence L. Persons, 73, retired chief engineer and assistant to the executive vice-president, Burlington Route, Chicago, died June 30. Mr. Persons entered the civil engineering department of the Burlington Railroad in 1904. He became chief engineer in 1918. He was advanced to his last position in 1939.

Meters in parking lots reduce operating costs

Parking meters in city-operated parking lots now allow maintenance expenses for these facilities at Miami Beach, Fla., to vary automatically with population changes, according to the American Municipal Association. The new parking system is designed also to reduce traffic and parking congestion during the tourist season, when the city's population soars from 30,000 to 100,000.

Meter fees are graduated according to location. In one large lot parkers in the rows nearest the stores pay five cents for 60 min., while the same fee buys 90 min. parking time in slightly less convenient locations. Twentyfive cents provides all-day parking in some spaces.

Charles River Boulevard proposed in Boston

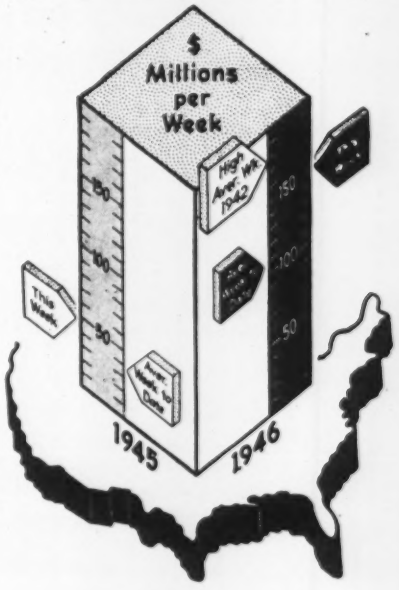
The Massachusetts legislature will be asked to authorize the construction of a 6-lane Charles River Boulevard, to run parallel with the river between the Esplanade and Beacon Street, Boston, as another step in eliminating the city's traffic congestion. The plans, which have already been made, have the approval of Governor Maurice J. Tobin and Mayor James M. Curley.

Officials of the Boston Planning Board estimate that it will cost less than $6,500,000 to complete the highway. It would do much to relieve traffic congestion and cut down the time for motorists going from the Back Bay to down-town Boston.

Anderson re-appointed Va. highway commisioner

Gov. William M. Tuck of Virginia has reappointed James A. Anderson as state highway commissioner for a term of four years. General Anderson, a former dean of engineering at Virginia Military Institute, Lexington, succeeded the late Henry G. Shirley in 1941.

CONSTRUCTION ACTIVITY



As Reported this week to ...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of July 11 1946	Cumulative 1946 (28 wks.)	Cumulative 1945 (28 wks.)
Federal	$40,158	$390,695	$528,441
State & Mun.	37,371	708,137	147,743
Total Public	$77,529	$1,098,832	$676,184
Total Private	73,064	1,807,459	279,800
U. S. Total	$150,593	$2,906,291	$955,984

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (28 wks.)	Cumulative 1945 (28 wks.)
Waterworks	$4,125	$51,624	$22,219
Sewerage	2,807	49,498	15,584
Bridges	3,416	68,344	13,565
Highways	23,153	406,830	107,582
Earthwork, Waterways	6,496	230,093	21,066
Buildings, Public	24,418	193,679	324,871
Industrial	17,617	563,515	190,205
Commercial	54,317	1,132,439	55,175
Unclassified	14,244	210,269	205,717

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (28 wks.)	Cumulative 1945 (28 wks.)
NON-FEDERAL	$565,697	$466,188
Corporate Securities	203,131	90,408
State and Municipal	362,566	212,180
RFC Loans	.....	24,600
REA Loans	.....	60,000
Fed. Aid Highway	.....	79,000
FEDERAL	158,320	1,005,325
Total Capital	724,017	1,471,513

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	July '46	353.89	170.11
Building Cost	July '46	266.13	143.86
Volume	June '46	344	151

EDITORIALS

VOLUME 137 NUMBER 2

July 11, 1946

Long Highway Service

A FEW WEEKS AGO we commented on the disadvantages of making frequent changes in the administrative heads of public departments for what appear to be chiefly political reasons (*ENR* May 16, vol. p. 62). Fortunately, that practice is not common to all states. An example is Virginia, where the highway department this week celebrates its 40th anniversary. In that period the highway commission has had only four chairmen, and one of these, Henry G. Shirley, had served nearly 20 years at the time of his death in 1941. He was succeeded by J. A. Anderson, who has just been reelected for another four-year term. The present chief engineer, C. S. Mullen, has served the department for 38 years, and 16 of the department staff have served over 25 years. In the 40 years that the department has been serving the state it has been kept notably free from politics. As a result, it has attracted and held men of ability who sought to make a career in highway work. Virginia can well be proud of the long record of its highway department and of the men who have made it what it is as it starts a new decade of service.

Landfills and Health Hazards

REGARDLESS OF THE MERITS or limitations of sanitary landfill practice as compared with other methods of refuse disposal, the time is long since past for any questions to be raised about possible *health hazards* from a properly conducted fill operation. Experience for more than a decade at two of our largest cities—New York and San Francisco—as well as that with scores of Army camps never produced any evidences of a health menace. In fact, strongest endorsement so far as public health and safety aspects are concerned was given in 1939 by a distinguished board of sanitary engineers and doctors who reported on New York City practice under the chairmanship of Dr. Thomas Parran, Jr., surgeon-general of the U. S. Public Health Service. Despite all of this, the head of a new administration in New York City now declares that landfills are a menace to health. As a consequence, he wants five incinerators built at an average cost of $1,500,000, exclusive of land, and 13 existing plants put into full operation. Two conclusions may be drawn from the mayor's jronouncement—Either landfill operations are being incompetently managed as compared with practice under a former administration or there are reasons far more subtle than alleged health hazards for the abandonment of a refuse disposal system that was once reported to be about five times cheaper than incineration in New York City. People outside of New York who are interested in the landfill method of refuse disposal will do well to give weight to these conclusions. Landfill methods have not become a health menace over night.

Incentive for Efficiency

INCREASED MONETARY RETURN still seems to be an effective incentive for production, as has been shown by the success of an Ohio builder who paid premium, though currently illegal, wages for top grade mechanics and achieved thereby substantial economies and speed in construction (*ENR* July 4, p. 2). Significant in a Wage Adjustment Board finding on the case is the fact that labor members of the panel apparently were not perturbed by the idea of premium wages for men who produced quantities above the average. During the current labor shortage it probably is essential that wage ceilings be enforced. But there seem to be many reasons for those interested in promoting quality and quantity of construction to investigate means of rewarding those who can and will do good work. As wages now are set up, about the only reward a workman gets for being a skilled and conscientious craftsman is added and more difficult work to do at the same pay as the shirker who stays in the shade all he can. Abuses of varied pay rates have in the past caused workers to fear the incentive system. But for the good of the efficient workers as well as for construction in general, it is desirable to increase the interest in craftsmanship. Until other means to accomplish this are found, it seems advisable to give consideration to better pay for efficient workers.

Continuing Inspection Needed

A PIER COLLAPSED recently in Philadelphia, carrying four men to their deaths, a small synagogue crumbled into rubble in Brooklyn just after a service, and a serious accident to a famous church was narrowly avoided through the accidental discovery of badly rotted beams supporting the central crossing. These recent examples of structural accidents or near accidents point to a continuing condition that should be of deep concern to civil engineers. We

now have laws designed to give reasonable assurance that buildings are designed by competent men and that their designs are followed during construction, but we have no adequate check on the continuing stability of our structures other than those that are covered by indemnity insurance. Some large corporations like the railroad companies make periodic examinations of their structures, and most bridges under the control of state highway departments or city public works departments similarly are checked, but many bridges on secondary roads and in small towns get no such supervision. And most buildings are in the same category, especially those owned by religious or fraternal organizations. What appears to be needed is a periodic inspection similar to that conducted by fire insurance companies to uncover fire risks. How this should be done most effectively is a question that might well be studied by some of the engineering societies.

Hot Weather Reveries

ENGINEERS have a responsibility to furnish the humane, scientific understanding and constructive action necessary to attainment of an orderly world society. That big order was put up to some 800 perspiring engineering educators one hot day recently at St. Louis. And now on another hot day in New York, we are wondering whether that statement does not indicate that engineers as a group take their mission in life just a bit too seriously. Speakers at the St. Louis meeting went on to tell the teachers that it was their task to prepare their students for effective participation in the solution of social and economic problems. Presumably, this training still will have to be sandwiched in with teaching the boys how to solve a few engineering problems.

Responsibility for an orderly world society rests no heavier on engineers than on any other citizens. True, engineers are trained to follow exact or logical processes in solving their problems, but that training does not place any additional or peculiar moral responsibility on them for seeing that the world uses aright the facilities and forces that engineers make available.

Further, it appears highly probably that the logical and analytical type of mind that turns young men toward engineering is the type that is least likely to take an active interest in public affairs with the compromises that are inevitable in such activities.

Under these circumstances it is unfair to the engineering educators to charge them with responsibility for turning out graduates who will be equipped to set the world in order, at least until more than four years are given to them in which to train men for an engineering degree. Those four years now are so crowded with courses in the fundamentals of engineering that the students have no time for the extra-curricular activities that would do so much to broaden their outlook and interests. Certainly, no significant additions in the way of formal courses in the humanities can be made.

But that does not mean that the engineering teachers cannot do much more than most of them are doing today to start their students on the route toward taking their full share as educated men in world affairs. They can do much by example and by the way in which they teach the engineering subjects assigned to them. Thus, history can be woven into the teaching of bridge building, a recognition of the social significance of an irrigation project like that in the Columbia Basin in Washington can be used to lighten up the teaching of hydraulics, or a discussion of the problems raised by proposals to decentralize industry can be injected into the study of municipal engineering or even highway design. The extent to which this type of teaching will be effective in broadening the outlook of the students is limited only by the enthusiasm and ingenuity of the teacher. For example, teachers can use the student chapters of national engineering societies as an effective agency for broadening the interest of their students in national as well as technical issues.

And the more interest a teacher takes in world affairs and in the work of technical and professional societies, the greater will be his capacity to stimulate a like interest on the part of his students.

Here then is the real challenge to engineering educators in today's situation. Theirs is not the problem of finding time for courses in the humanities; it is the problem of organizing their own thinking and activities so that by their leadership they can give reality to the professional, national and international issues that their students must face in the years ahead.

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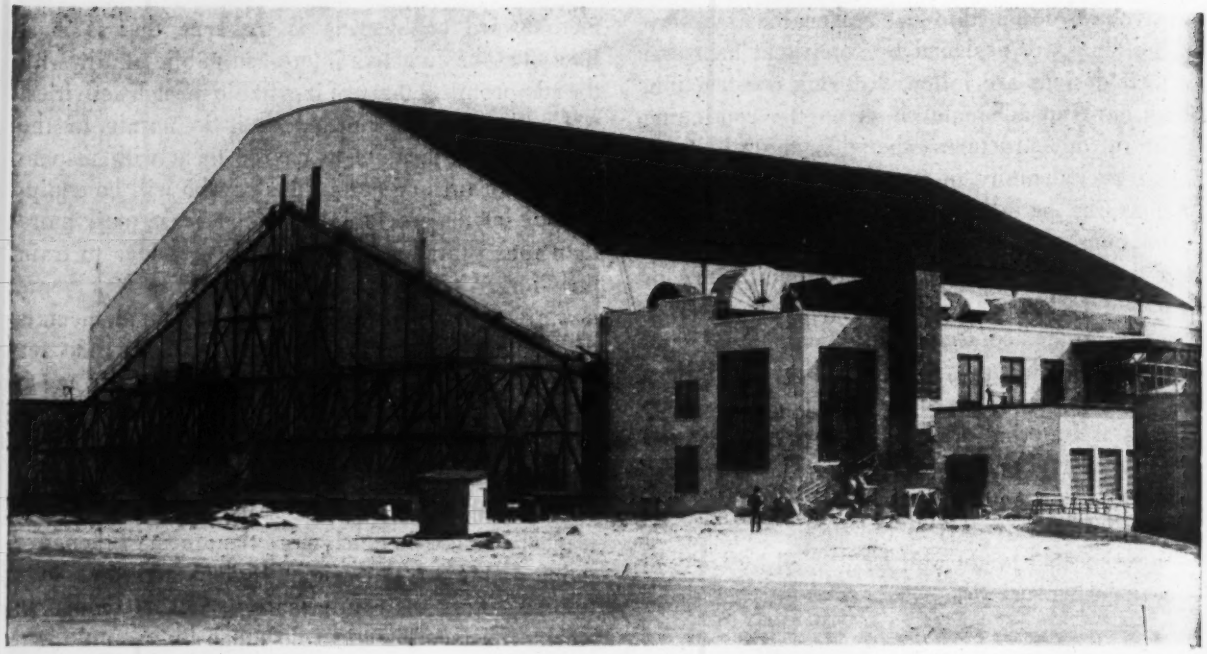


Fig. 1. The heavily insulated hangar has a flexible air conditioning system and special steel-frame door leaves.

Unique Hangar Built for Army Test Work

***Contents in Brief**—To permit the largest army aircraft to be tested at extreme temperatures, the floor of a 200 x 250-ft. hangar was made 34 in. thick, and for the walls and ceiling 13 in. of insulation was used, special precautions being also followed to protect the roof trusses from the low temperatures. To provide a tight joint at the edges of the heavily insulated door of the main opening, the leaves are mounted on trucks in a manner to permit both longitudinal and transverse movement. The extremely flexible air conditioning system used provides accurate control of both temperature and relative humidity over a wide range.*

A HANGAR designed to permit the largest army aircraft to be tested at any temperature between minus 70 and plus 165 deg. F. is nearing completion by the U. S. Army Engineers at Eglin Field, Fla. The structure is the first of its type ever built, and numerous unique features are incorporated in its design.

The hangar proper measures 200 x 250 ft. It has an inside height of 35 ft. at the walls, and is 70 ft. to the ceiling at the center, the air conditioning ducts suspended from the roof trusses reducing the actual clear heights to 25 and 60 ft., respectively. At either side a two-story lean-to with a reinforced-concrete frame is provided. One lean-to houses the physiological laboratory and the other the air-conditioning equipment, together with storage rooms and shops.

Functional requirements for the hangar were severe. On low temperature tests the temperature inside the hangar and that of its contents—estimated at 600,000 lb. of aircraft and equipment—must be reduced to —70 deg. F. in 48 hr. though the outside temperature might be 95 deg. dry-bulb and 80 deg. wet-bulb. A 24-hr. "soaking" period with the temperature in the hangar at –70 deg. is specified. Then, this temperature is to be maintained within a few degrees, although an internal combustion engine of about 2,500-hp. capacity with a heat output of 160,000 Btu. per min. is operated periodically within the hangar.

On high temperature tests the hangar and its contents must be heated from an ambient temperature of 25 to 165 deg. in 16 hr. The humidity in the temperature range of 50 to 165 deg. must be controlled at any value between a minimum of 10 percent and a maximum of 95 percent, until a vapor pressure of 1.5 in. of mercury is reached. It was also required for the temperature range from —70 to +165 deg. that the temperature and relative humidity inside the hangar be automatically maintained within 2 deg. and 3 percent, plus or minus, of the desired values. A final requirement was that the cooling and heating systems be designed around six cooling and dehumidifying plenums of equal capacity arranged to serve either or both the hangar and a 34 x 132-ft. test room in a separate building adjoining the south lean-to.

Because of the extreme variations of temperature to be provided inside the hangar, the design of all parts of the structure required the solution of numerous special problems. The floor was no exception and was made 34 in.

thick in concrete and insulating materials. It is designed for a 150,000-lb. wheel load (plane weighing 300,000 lb.), the pressure on the cellulated glass insulation used in the floor being limited to 35 psi.

The floor subgrade is sand, adequately drained. After this material had been well compacted, a 7-in. plain concrete base slab was put down. A mat of 2-ply, 55-lb. saturated-asbestos felt was next added, followed by 15 in. of cellulated glass block insulation applied in three layers and with staggered joints (Fig. 2). Finally, after the top layer of blocks had been covered with three layers of the felt, a 12-in. reinforced-concrete floor was constructed. This slab was built in alternate squares measuring 12 ft. 6 in. each way, a ½-in. expansion joint being provided between adjacent squares.

All the joints in the finished floor were made waterproof with a sheet copper seal. Below the seal, a standard expansion joint filler was used but above it a hot-poured synthetic rubber compound of high resilience at extreme low temperatures was added.

Several deflectometers were placed in the upper concrete slab to measure movement of the floor. Some 60 thermocouples were also installed in the floor insulation, in the underlying sand, and in the walls of the hangar. These units will assist in the temperature research work.

Design of the drains in the floor is distinguished by the fact that it is proposed to use special plugs to prevent heat transfer from the drainage system on low-temperature tests. A small supply of effervescent salts in a thin paper bag, which will disintegrate immediately upon the application of water, is one type of plug being studied. Another type is a thin pure rubber diaphragm that would rupture when filled with water.

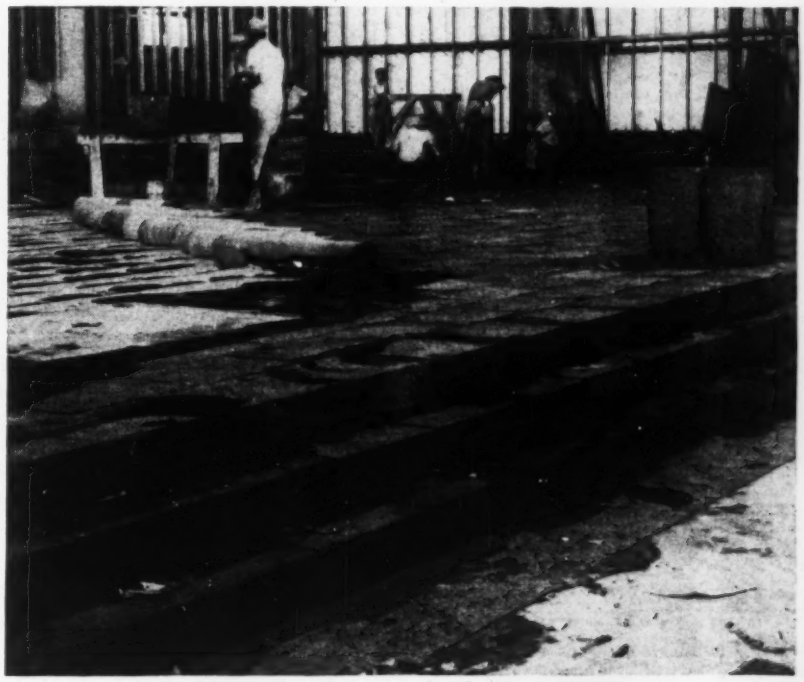


Fig. 2. To insulate the floor of the hangar, 15 in. of glass block put down in three layers was used. The blocks rest on a 7-in. plain concrete slab and were covered later with a 12-in. reinforced-concrete finished floor.

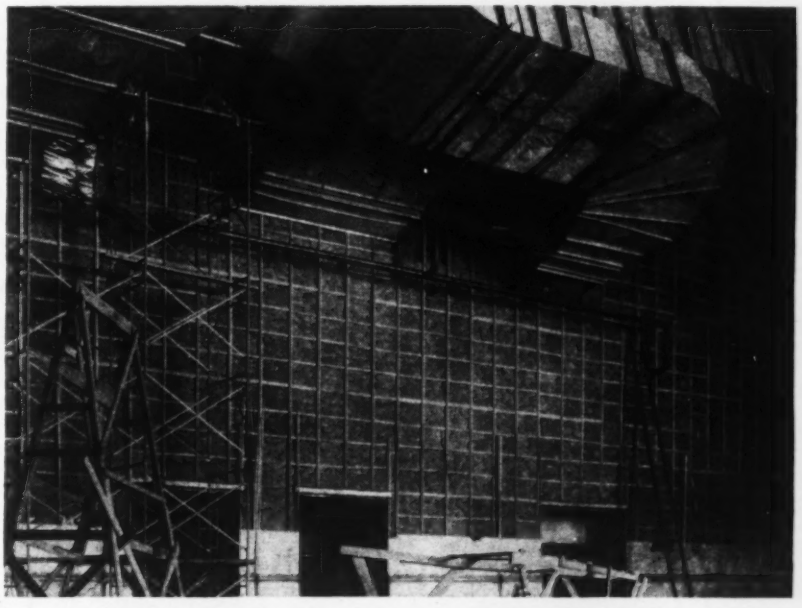


Fig. 3. A total thickness of 13 in. of glass fiber insulation is provided in the sidewalls and ceiling. That in the walls is supported in a wood framework to permit the circulation of air between the insulation and the exterior vapor barrier, which is already in place at the base of the wall.

Walls have thick insulation

Construction of the hangar was also distinguished by the thick insulation built into the walls and the ceiling, and by the method of suspending the ceiling insulation from the roof trusses. Where the sidewalls are common to the lean-tos the tile panel walls of the lean-tos were supplemented by an interior vapor barrier of galvanized sheet iron with welded joints, 13 in. of glass fiber insulation and an exterior sheet metal vapor barrier with soldered lock-seam joints (Fig. 4). Between the interior barrier and the glass fiber and between the insulation and the exterior barrier a 1⅝-in. air space is provided. The insulation is supported in a wood framework, and air can be circulated through each air space should this become necessary to remove any vapor collecting in these spaces. The design also provides for draining away precipitated moisture in the air spaces.

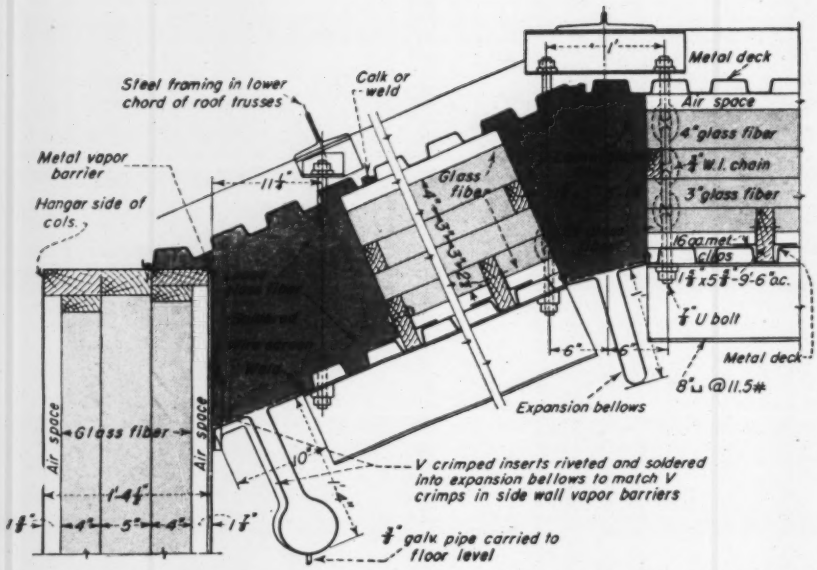


Fig. 4. At both faces of the sidewall insulation, an air space and a metal vapor barrier is provided, as shown on the left. Similar construction was used for the ceiling insulation, which is suspended from the roof framework with chains as shown at the right. Because of the extreme temperature variation to occur in the hangar, expansion bellows are provided on a frequent spacing in the ceiling insulation.

Above the lean-tos the sidewall construction is much the same, except the tile panels are replaced by corrugated asphalt-protected steel sheets painted on the exterior side with aluminum paint. Similar construction was used for the front wall area above the main door opening, which is 246 ft. wide, 25 ft. high at the sides and 60 ft. at the center.

For the rear wall, a structural steel frame stiffened with an exterior bracing was constructed. The exterior surfacing over this framework consists of corrugated asphalt-protected steel sheets, and on the inside two vapor barriers and 13 in. of insulation were used, as for the sidewalls.

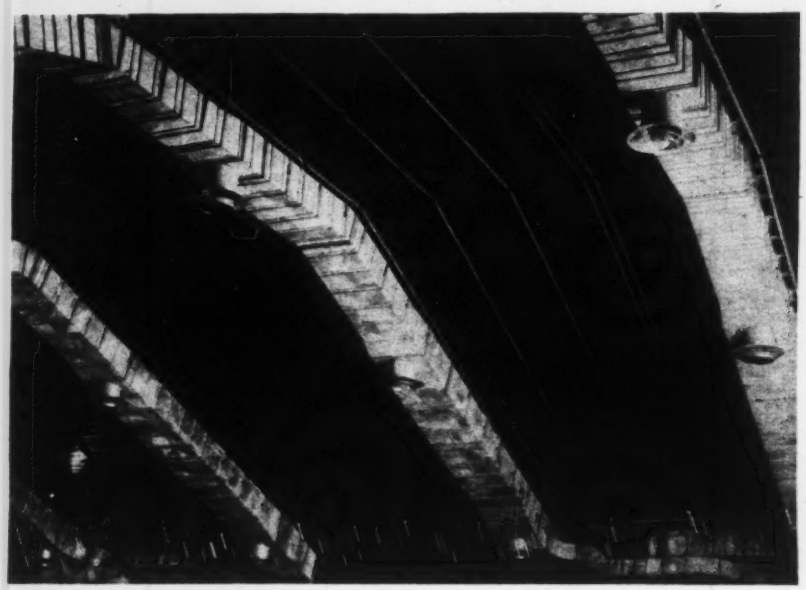


Fig. 5. Conditioned air is delivered to the hangar by four ducts suspended from the ceiling, uniform distribution being obtained through adjustable diffusers. Running parallel to the ducts are the 8-in. channels that support the ceiling insulation.

Steel trusses used for roof

Due to the extremely high rudder assembly on large planes it was necessary to obtain much more vertical clearance at the building centerline than at the side walls. Two roof framings by which this result could be obtained were considered—an arch roof layout and a modified camel-back truss design. The arch was ruled out because the foundation and buttress design would have complicated and delayed construction of the lean-tos, and arch movement due to expansion and contraction would have a detrimental effect on the vapor-proof barriers of the insulated ceiling. The modified camel-back steel truss design selected called for tying the truss to a column at one end while a rocker type expansion joint was need at the other.

The trusses are spaced 25 ft. on centers and are supported on the reinforced-concrete columns common to the lean-tos. They have a span of 252 ft. and vary in depth from 14 ft. at the walls to 24 ft. at the center.

To protect the trusses from extreme temperatures, the roof insulation was suspended from the lower chords as a ceiling. This insulation is almost the same thickness as that on the sidewalls, but the vapor barriers were made of metal deck units (Fig. 4) The ceiling is supported on 8-in. 11.5-lb. channels running parallel to and suspended from the bottom chord by wrought iron chains, which are expected to permit a minimum heat transfer from inside the hangar to the roof framework. Details of this method of support are shown in Fig. 4. Expansion joints are provided to break up the 60,000 sq. ft. of ceiling area into 40 x 50-ft. panels.

The exterior surfacing for the 50-ft. wide flat center section of the roof consists of a metal deck covered with a 1-in. thickness of wallboard and a three-ply felt. On the sloping portion of the roof the 1-in. insulation was surfaced with asphalt-protected steel sheets.

The main opening at the front end of the hangar is closed by two horizontally sliding door leaves of an unusual design (Fig. 6). Each leaf consists of a structural steel frame covered on

the outside with a 1-in. thickness of insulation and corrugated asbestos sheets, and on the inside by a $\frac{3}{8}$-in. thick steel plate, 13 in. of glass fiber and a vapor barrier of galvanized sheet iron.

Weighing approximately 275 tons, each leaf is supported entirely free of the hangar on eight 4-wheel trucks operating on two parallel tracks spaced 25 ft. c. to c. Power for moving the doors is supplied by electric motors mounted on four of the eight trucks.

Special attention was required to make the 700 lin. ft. of joint along the edges of the door vapor tight. It was specified that the total infiltration of air through this joint not exceed 1,000 cfm. with 0.735-psi. differential in vapor pressure on two sides of the door.

This problem was overcome by supporting the door frame on a series of rollers mounted on the truck frame. This design permits manually-operated electric motors to move the entire door leaf approximately 3 in. sidewise towards the building or at right angles to the tracks, once the leaf has been moved to the desired position along the rails. As the door moves sidewise, rollers on the ends of threaded arms on the door engage clamps on the building at about 30-ft. intervals. Along the edges of the door leaf a continuous "weathering" strip, consisting of a think semi-circular piece of rubber, is provided, and as the door approaches final position, a system of bevel gears and threaded rods operated by electric motors causes the weathering strip to come in contact with a steel bearing plate on the hangar structure.

A tight joint at the bottom of the door is secured by a moveable continuous steel member built in the bottom of the leaf. When the door is in final position, this member is thrust downward a few inches by motor-operated gears to bring the weathering strip in firm contact with a steel plate imbedded in the concrete slab. Back of the bearing plates an electrical heating element is provided for the entire circumference of the door to "de-ice" the joint after low-temperature tests.

In closing the doors, all operations are controlled by a single operator in the cab on each leaf. Power is received through a system of collector rails on the building above the door. It is possible to move a leaf from open to final closed position in 15 min.

For air conditioning the hangar and the lean-tos, three independent multi-stage centrifugal compression systems were selected. Each system is equipped with two banks of air cooling coils and two 78,500-cfm. circulating fans especially designed for low-temperature operation and driven by 100-hp. motors. The first-stage compressor, which consists of a four-stage turbo unit driven by a 1,000-hp. motor, discharges through intercoolers to the second-stage compresser. The latter is a three-stage turbo compressor driven by a 1,250-hp. motor, and the refrigerant liquid from the condenser of this compressor is fed back through the intercooler to a low-pressure receiver for recirculation through the cooling coils. Likewise, the flash gas from the low-pressure receiver returns to the suction of the first-stage compressor.

Each of the three refrigeration systems is provided with a 30-in. by 12-ft. condenser of the multipass-shell-and-tube type. The main cooling coils are in six banks and are of the staggered-tube crinkled-fin design. Each bank is provided with 44 liquid feeds for circulation of Freon 12 at about 750 gpm. when cooling 78,500 cfm. of air.

Air cooled in three stages

Air added from the outside is cooled in three stages. In the first stage its temperature is reduced to 40 deg. and in the second to 5 deg. In this latter stage an ethylene-glycol spray keeps the coils free of frost and the moisture is absorbed by the glycol and removed in a continuous automatic concentrator. For the work at extremely low temperatures the 5-deg. air is further cooled to minus 70 deg.

Two banks of main heating coils are utilized. Each bank has a capacity of 10,000,000 B.t.u. per hr. at 100 psi. steam-pressure when heating 110,000 cfm. of air entering at 150 deg. The 110,000-cfm. circulating fan for each bank of coils is driven by a 100-hp. motor located outside the plenum room.

Air is carried to the hangar through

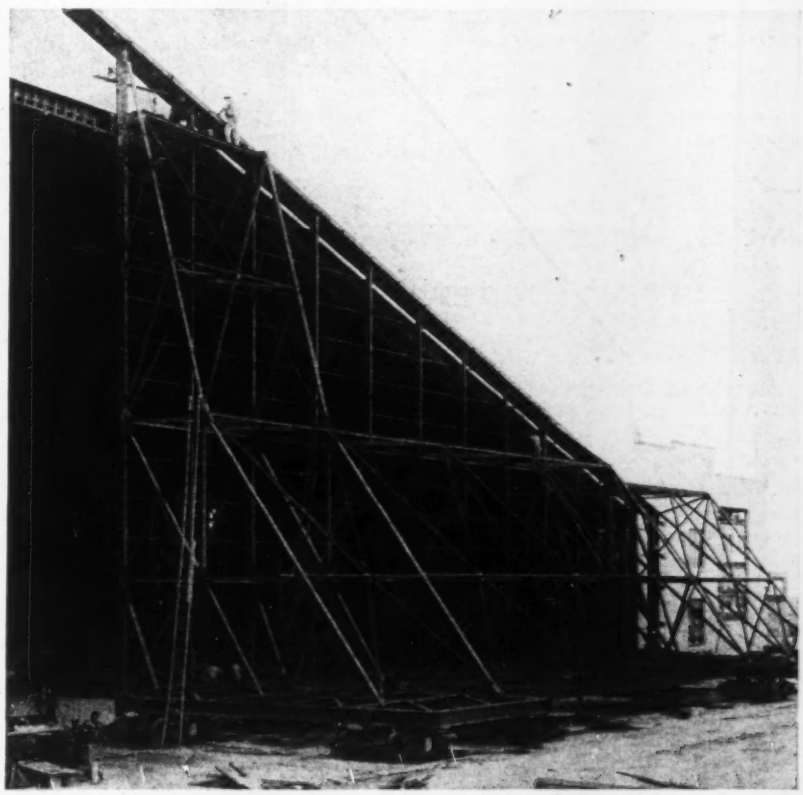


Fig. 6. Two steel-frame leaves each mounted on eight 4-wheel trucks are used to close the 246-ft. wide main door opening of the hangar. The inner face of each leaf was later covered with a 3-8 in. steel plate, 13 in. of glass fiber insulation, and a metal vapor barrier.

heavily insulated galvanized iron ducts; inside the controlled temperature spaces the insulation is, of course, omitted. Within the hangar four distribution ducts suspended from the ceiling are provided (Fig. 5). The air is returned through grills in the south wall to insulated return ducts.

Uniform distribution of air within the hangar is accomplished by adjustable diffusers on the duct lines, the maximum temperature difference between floor and ceiling being limited to 15 deg. Variation in the rate of supplying fresh air make-up is obtained by adjustment of the dampers from the central control board. Provision is made for the introduction of 50,000 cfm. of fresh air for "flushing" the hangar.

Flexible steam plant required

A careful analysis of the heating problem revealed the necessity for a flexible steam-generating system. Calculations placed the maximum demand at 945 boiler hp. This capacity was considered sufficient to raise the hangar temperature to 165 deg. in winter in 16 hr., and to heat the lean-tos and provide hot water and process steam.

To meet these heating demands, installation of two 320-hp. water-tube boilers, and one 89-hp. fire-tube boiler was decided upon. The larger boilers normally will be operated at 150 percent nominal rating and in an emergency at 200 percent, which permits a variation from 320 to 960 boiler hp. at or near points of maximum efficiency and a possible maximum of 1,280 hp. The small boiler will readily take care of the minimum summer load.

Lighting of two types

Lighting units of two types are employed. Fluorescent fixtures were installed in the office and laboratory areas and in candescent lights in the hangar and machinery and boiler room areas. The units in the hangar are high-bay fixtures utilizing 300, 500 and 750-watt lamps. Incandescent lights, rather than fluorescent units, were chosen for this space because of the impossibility of vaporizing mercury under extreme low temperatures.

In view of the low temperatures during some tests, choice of the fire protection facilities had to receive special attention. The hangar space is protected in part by five thermostatically-operated deluge type automatic sprinkler systems suspended from the ceiling. These systems are supplied with water from five 6-in. dry-pipe valves located outside the hangar space along with rear wall. The valves are connected to a 600,000-gal. ground reservoir through four 2,500-gpm. centrifugal fire pumps that start one after the other as the pressure drops or successive dry-pipe valves open. The attic space above the insulated ceiling is protected by two thermostatically-operated dry-pipe sprinkler systems suspended from the roof structure.

Within the lean-tos, observation rooms are provided to permit personnel to observe operations within the hangar without being subjected to the test temperatures. The observation windows, which measure 3 ft. 6 in. by 5 ft. 6 in., had to be designed both to resist heat transfer and to avoid frosting. The windows consist of seven thicknesses of ¼-in. plate glass separated by ½-in. air spaces. Each space is filled with totally dehydrated air and is sealed to prevent condensation or frosting, which would obscure vision.

Design and construction of the hangar was carried out under the direct supervision of the U. S. District Engineer Office, Mobile, Ala., and the general supervision of the Division Engineer, Office of the South Atlantic Division, Atlanta, Ga. The structure will be operated by the Army Air Forces.

A.E.D. Directors Criticize Government Surplus Property Disposal Plan

Agitated by the existing bottleneck in disposal of government surplus material, the committee on disposal of surplus equipment at a recent meeting of the directors of the Associated Equipment Distributors in Chicago passed a resolution containing, among others, the following contentions:

The Surplus Property Act of 1944 is proving to be an ineffectual means of disposing of the surplus property of the government to get it into the hands of ultimate consumers, and that the system of priorities and preferences leads to the exploitation of holders of such priorities and preferences.

That billions of dollars of surplus are now in storage, little is being sold and what is sold is being used to feed speculative markets.

Rapid disposal now would retard inflation, stimulate re-employment, expedite reconversion, help housing, increase food supply, reduce national debt, prevent black markets, retard speculation, prevent excessive profits, absorb the surplus now when it can be done without shock to our national economy, and discourage monopolistic practice and the hoarding of critical materials and equipment.

The resolution concluded with these seven recommendations:

"That all priorities, preferences, and special privileges be eliminated during an interim period of one year.

"That this surplus personal property and consumer goods be disposed of on the open market to all comers and buyers at public spot sales, at highest bid price, publicly advertised well in advance of sale utilizing normal channels of trade and commerce to the extent consistent with efficient and economic distribution without the establishment of new enterprise.

"That such property be sold in small lots that will afford all classes of prospective purchasers an opportunity to buy.

"That there be no negotiated transactions of any kind.

"That without regard for other provisions of the act, all surplus personal property be sold to obtain for the government and the American taxpayer the maximum value.

"Where large inventories of surplus are concentrated in a small area, sales be handled on a national basis in order to get a wide and equitable distribution.

"That our national economy can best be served by a rapid dumping of surplus personal property during the interim period but that the government maintain a constant survey of market conditions to avoid dislocations of the domestic economy by retarding sales when such survey indicates an impact on industry."

Piers and Wharves on Steel Cylinders

Eugene H. Harlow
Foundation Engineer with Frederic R. Harris, Consulting Engineer, New York City

***Contents in Brief**—Steel cylinders as bearing members offer many advantages over other methods of support for piers and wharves in deep water. Greater rigidity for high unsupported lengths reduce the lateral bracing required and this, with fewer bearing units, decreases the silting that frequently occurs at waterside structures. Tests recently have shown that it is not necessary to clear muck from the cylinders and fill them with concrete as the shells are adequate load bearers.*

DURING the past few years, a number of waterfront structures have been designed and built using steel cylinders as the foundation unit. These structures have many advantages compared to conventional wood pile types. They are adapted to much deeper water and heavier loads than can be allowed in a wood pile design since, in the latter, the allowable column load per pile for depths of water more than 35 ft. is reduced to an uneconomical degree.

The smaller number of foundation units required tends to reduce the silting that generally occurs under and behind the structures. Where they are located parallel to the direction of silt-bearing currents, this is sometimes of prime importance, many failures having been attributed to earth slides resulting from silt accumulations.

Greater rigidity of the load carrying unit permits also a reduction in the amount of bracing required against lateral forces. These structures present a much cleaner appearance than most other types, owing to the wide spacing and uncluttered orderliness of the supporting members.

Use of the steel cylinder design offers many advantages in reliability. Uncertainties as to the column strength of long spindly piles are eliminated, because the cylinders can be made as large and strong as desired. Loads can be imposed up to the limit of the bearing capacity of the soil. This can be determined theoretically, with fair accuracy, and if necessary verified in the field under actual static loading, which becomes an economical possibility when the total number of foundation units is so reduced, and each unit is so important.

Early uses of large open-ended driven cylinders as foundation units include the Rotinoff caisson as developed in Europe. This is a hollow, open-ended concrete cylinder made up in short sections, which is driven with a specially constructed hammer. The hammer weight can be increased gradually during driving until a maximum of over 30 tons is attained. Soil within the cylinder is removed by compressed air which is injected near the bottom, until the last few yards of driving, when a solid inside plug is allowed to form. The upper portion of the caisson is then filled with concrete. During load tests conducted by the Dutch Government in 1935, such a caisson 4 ft. in diameter with walls 6.3 in. thick, driven 40 ft., with a penetration of about 13 ft. into a layer of fine sand, sustained a load of 470 tons, with a settlement of about 0.8 in.

More recently, steel cylinders have

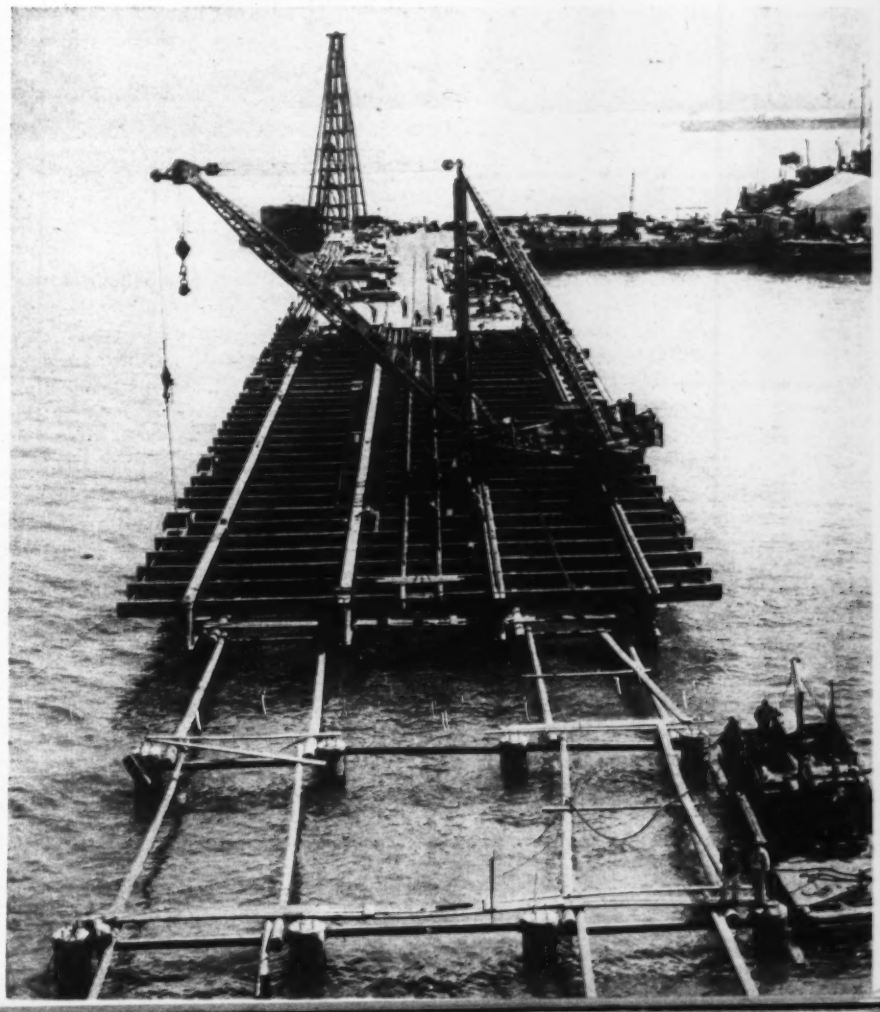


Fig. 1. Heavy structures in deep water can be supported on steel cylinders with a minimum of lateral bracing.

Fig. 2. The steel cylinders that support this pier at Algiers, La., are 65 ft. from deck to supporting ground and each will carry 200 tons. Open design keeps silting to a minimum, an important factor on the muddy Mississippi. Bituminous paint is being applied to the cylinders at the left to prevent deterioration by corrosion.

been used in the design of several piers and wharves. One of these designs was for a concrete wharf supported on concrete-filled steel cylinders, which was built at the plant of Todd-Johnson Dry Docks Inc., Algiers, Orleans Parish, Louisiana, in 1942.

High wharf for drydocks

The wharf is of concrete beam and slab design, supported on cylinders of 4-ft., 4-ft. 3-in. and 4-ft. 6-in. dia. It was designed to serve as a mooring for the operation of several floating drydocks, one of which is of 18,000-ton capacity. For this dock a minimum depth of water of 46.5 ft. was required at the face of the wharf. Since the Mississippi River at this location has variations in level of about 20 ft., the elevation of the deck of the wharf was chosen as +23.0 based on mean low water of +0.4 ft., making the total height of the structure from dredged bottom to top of deck 69.5 ft.

Being located parallel to and about 160 ft. from the river levee, careful consideration had to be given to the accumulation of silt and fine sand that might be impounded behind the wharf during flood stages of the river. The use of relatively few foundation units, with cylinders 18.5 ft. apart in bents spaced generally 20 ft. on centers, was considered to be the most economical design and the one best adapted to these requirements.

The structure was designed for a 500 lb. per sq. ft. live load, a 25,000-lb. concentrated load, plus reactions from a 40-ton locomotive crane on a standard-gage track, and from a 30-ton gantry crane traveling on rails 25 ft. apart. Maximum reactions at the tops of the 4-ft. 6-in. cylinders from dead and live loads were as high as 400,000 lb. Connections between the tops of the cylinders and the concrete girders were reinforced to take fixed-end bending moments. Driving of the cylinders to an embedment of about 45 ft. below the bottom grade provided sufficient lateral fixity so that no batter piles or other lateral bracing were provided.

Borings showed the substrata to consist of soft silt and bluish gray clay from the existing bottom to about El. —45, fine gray sand to about El. —135, where two borings carried to El —150 encountered a bed of bluish gray silty clay. Laboratory tests indicated that the fine gray sand was at or above the critical density and could safely support the maximum unit loads (about 17 tons per sq. ft. without deducting side friction) imposed upon it by the cylinders.

Four untreated douglas fir test piles about 100 ft. long were driven to depths between El. —75 and —88, and subjected to loads up to 30 tons. By correlating the data from these inexpensive tests with data from laboratory triaxial shear tests on selected samples of the fine sand, a reliable indication was obtained as to the required penetration of the cylinders in order to develop the desired bearing capacity.

Resistance to penetration comes partly from friction along the sides and partly from bearing at the lower end. The lower-end bearing values for cylinders driven deep into a sandy material are very high, much higher than values ordinarily considered in most building codes, for instance. This is especially so if the sand is above the "critical density", or that density at which shearing deformation can take place with neither expansion nor contraction along the shearing surface. The reason is that before the sand below the cylinder can fail and move aside, it must move upward the adjacent material, lifting a large volume of sand around the periphery of the deeply embedded column, overcoming the weight of this mass multiplied by the tremendous frictional resistance in converting the downward load to an upward thrust.

In this connection, Terzaghi has published at various times methods for calculating the ultimate bearing capacity of circular and square piers, most of which are summarized in his recent book, *Theoretical Soil Mechanics*, (John Wiley, 1943).

Cylinders in 8-ft. lengths

Construction of the wharf at Algiers was accomplished in about five months from the time of driving the first caisson, the rate of delivery of the steel cylinders being the limiting factor on construction speed. A special single-acting hammer with an 8,000-lb. ram and a special driving head was used. The cylinders were reinforced at the lower end to prevent damage from obstructions, and were made up in 8-ft. lengths, with backed butt-welded joints. Driving was accomplished to designed

elevations with but few serious difficulties, the resistance encountered in the last foot averaging better than 40 blows.

Cylinders excavated and filled

Material was removed from the interior of the cylinders by means of an air lift. This consisted of a 6-in. pipe, with a saw toothed bottom edge, to which a 1-in. line was connected 1 ft. above the bottom. Water for using the pipe as a jet was provided by a two-stage jet pump and air at 125 psi. was supplied by two 160-cu. ft. compressors. During driving and excavation, a positive head of about 5 ft. of water was maintained in the caissons, since it was found early in the job that a negative differential of as little as 2 ft. was sufficient to cause a blow at the bottom. Excavation was carried down to within 8 ft. of the bottom, the remaining material being left in place as a plug. A 2-ft. layer of gravel was then placed in the cylinders to insure a satisfactory bottom, and concrete was pumped down directly into the cylinders through a pipeline.

In some instances, where driving resistance did not increase satisfactorily at the design depth, the cylinders were driven deeper, until a resistance of about 40 blows per foot was encountered. In two cases where further driving did not result in the desired increase in resistance, load tests were made. Tests also were made to determine whether the plug at the bottom of the cylinder settled under the weight of the tremie concrete by observing the motion of a steel plate placed in the bottom before concreting. Motion of the plate indicated that in some cases the sand had been loosened by the driving and excavating operations. Thereafter, extreme care was exercised to prevent such disturbance. Observations of the steel cylinder shells during concreting showed downward motion averaging about $\frac{1}{2}$ in.; pouring of the deck slabs later produced no motion of most of the caissons, the maximum observed being $\frac{3}{8}$ in. Behavior of the wharf after completion was in every way satisfactory, and it presents an extremely fine appearance.

A further development in the use of steel cylinders was in the construction of a large wharf at the Bethlehem Steel Co. shipyard in San Francisco in 1945, designed in association with L. H. Nishkian (*ENR* June 27, vol. p. 974). Driving with the standard type of single-acting steam hammer was inadequate to secure the necessary penetration, which was obtained by sinking each cylinder under a static weight equivalent to the full maximum design load to which it might later be subjected.

Concrete-filled steel cylinders 36 in. in dia. used in this wharf were designed for a maximum reaction at the top of the cylinders of 350 tons. The structure is 1,300 ft. long and 80 ft. wide, with bents spaced on 50-ft. centers and four cylinders to a bent.

The timber deck planking and stringers are supported by steel framing, with continuous plate girders, 66½ in. deep, running the length of the wharf along each line of cylinders (Fig. 1).

The cylinders were driven through 50 to 90 ft. of bay mud, 10 to 30 ft. of fine to medium sand and firm green clay. At depths of 130 to 140 ft., resistance was offered by a compact layer consisting of large serpentine rock fragments in a matrix of stiff clay. After being driven to refusal the bottom elevation of the cylinders varied from 130 to 177 ft. below mean low water.

Penetration by loading

To insure that each cylinder was capable of taking the design load of 350 tons, all the units were preloaded to at least 350 tons. The load was applied by filling large tanks with water, which were supported on frames balanced on adjacent cylinders. Several cylinders penetrated substantially further from application of this weight, one cylinder going down an additional 23.9 ft. Repeated tests showed that reapplication of loads up to 80 percent of the load used in sinking the cylinders would not produce further settlement.

The method of sinking cylinders to final position by means of a heavy static weight eliminates uncertainty as to the static bearing capacity. Although many driving formulas have been devised, by which it is attempted to determine the static load capacity from the resistance to the impact of a hammer, none of them is reliable except in certain special circumstances, and on important projects the driving data are generally supplemented by a few load tests. The method described above provides a "load test" for every foundation unit. The cost per cylinder can be made relatively small, if a preplanned procedure for applying the load to a large number of cylinders is used.

Still further economies are possible in the use of open steel cylinders for pier and wharf structures. In a recent design for a second wharf at the Todd-Johnson Dry Docks Inc. plant on the Mississippi River at Algiers, La., complete plans and specifications were prepared for a structure supported on 20-in. dia. steel cylinders without concrete or other filling inside.

Theory and experience have indicated that the concrete fill is not needed for structural reasons. Strength is provided by the steel shell itself to take bending stresses with ample factor of safety, even allowing for eventual loss of some metal from corrosive action. Also, the theoretical bearing capacity of an open steel shell driven into sand, with a sufficient plug of earth in the bottom, was calculated to be adequate to sustain safely the design load of 50 tons. To verify these findings, two test cylinders were driven to about El. —80 and loaded, by means of a water tank, to 100 tons. In each case the resulting movement of the top (El. + 27) was about 0.3 in., approximately equivalent to the elastic compression of the cylinder on the assumption of 100 percent point bearing.

The calculations and tests made in connection with this wharf design prove conclusively that the use of unfilled cylinders is sound and practical, and that under generally similar conditions it offers an economical type of structure.

Refinements forseen

There is still considerable refinement and development possible in the use of steel cylinders for foundations. It is believed, for example, that experimentation may prove a useful relation between the type of hammer used in driving and the ideal frequency of blows for obtaining maximum penetration. This will vary with the elastic characteristics of the hammer, pile and soil. Perhaps a special type of hammer might be developed, such as was used in driving the Rotinoff caisson previously mentioned.

This type of foundation has one particular advantage from the design standpoint, and that is that where field conditions result in unexpectedly low bearing at the designed penetration, the inadequacy can be corrected simply by driving deeper. Cylinders can be readily lengthened and no further redesign is necessary.

Fig. 1. Equipment here shown in the process of compacting a sand-clay base exemplifies the purpose of all the test-runway operations, namely, not to exceed the tools and processes that are ordinarily available.

Tests of Flexible Pavement For Airport Runways

Part I — Tests Structures and Loads

***Editor's Note**—In the last few years the Corps of Engineers, U. S. Army, has greatly extended the research and experimental work on airport design. An important part of this study has been an investigation of flexible pavements for runways to verify and perfect a method of design based on the California bearing-ratio method for evaluating subgrades. Included in the experiments were accelerated-traffic tests on four runways having flexible pavements of various kinds. A synopsis of the tests, based on the several reports of the Army Engineers, is given in this and a succeeding article. Apart from the original reports this information has not been published previously.*

INFORMATION on the design, construction and service behavior of airport runways has been greatly increased by the work of army engineers during the war. One phase of this work—an experimental study—has received little publicity although its importance reaches far beyond the marvelous emergency runway building in the war areas. This experimental study is directed to permanent construction for peacetime as well as wartime airfields. The review in this and a succeeding article is centered on the peacetime value of the research.

In 1942 the Corps of Engineers, U. S. Army, inaugurated an intensive experimental investigation of airport runways and other paved surfaces servicing warplane traffic. Test runways were constructed and subjected to accelerated traffic, and numerous existing airfield pavements were given traffic and other tests. In addition to these service tests, several hundred evaluation reports on failed and adequate airport pavements were analyzed.

The outstanding undertaking of the investigation was the building and testing of four experimental runways having flexible pavements. Description of the test runways and the test results derived from them are given in several voluminous reports.

Broadly, the test program divides into: (1) Development of the test mechanism and (2) the interpretation of the test findings and their application to practical design. Divided similarly, the subjects selected for review are: (1) Runway structures and test loads; construction methods and machines; construction control tests and test devices, and deflection and pressure measuring and recording devices; and (2) recorded deflections and pressures; deformation of pavement, and development of B-29 design curves.

Test runways, all with flexible pavements, were built at army airfields at Stockton, Calif., Eglin, Fla., Barksdale, La., and Marietta, Ga.; in about the order named over a period of three years.

Four test runways

At Stockton the test runway was built in 1942 on an existing taxiway on a black clay (adobe) subgrade. The taxiway pavement was 6 in. of sandy loam stabilized with an asphalt emulsion. The test runway was built as a ramp which, including the old pavement, varied in thickness of base and pavement from 6 in. to 48 in. The base consisted then of the 6 in. of old pavement and a superimposed fill of well-graded sand, gravel and crushed gravel. The pavement was 3 in. of asphaltic concrete. Deflection gages were set in the outside wheel track in the 40,000-lb. traffic lane at points where the thickness of pavement and base was 20, 26, 32, 38 and 45 in. The test wheel loads were 5,000, 10,000, 25,000, 40,000 and 53,300 lb., at each deflection point.

At Eglin the test runway, constructed in 1943, was 700 ft. long and 50 ft. wide, with three traffic lanes for 15,000, 37,000 and 50,000-lb. wheel loads. Each lane was divided transversely into 14 test sections. The subgrade was an unsaturated, free-draining, non-cohesive fine to medium sand to considerable depth. The thicknesses of pavement and base were from 4 to 12 in. for the 15,000-lb. traffic lane and 6 to 14 in. for the other lanes. The base materials were three grades of sand-clay. Two similar sections, varying in thickness, of each base were constructed; one had a 1½-in. and the other a 3-in. surface of asphaltic-concrete. Sections of mixed-in-place sand-asphalt 6 to 11 in. thick were also constructed directly on the sand subgrade. Pavement stability under test was recorded but no deflection or pressure measurements were made.

At Barksdale the test runway was an oval with two parallel test sections, one for 20,000-lb. and the other for 50,000-lb. wheel loads. The thicknesses of pavement and base were calculated on the basis of the California bearing-ratio design method. The subgrade was an in-place medium plastic clay. The pavement was 3 in. of asphaltic-concrete on: (1) a layered base with limestone blend directly below the 3-in. surfacing; (2) layered base with clay-gravel directly below the surfacing; (3) limestone blend to the full depth, and (4) soil-cement on a 4-in. layer of selected loam. Limestone blend is defined as: "A type of cohesionless base material composed of crushed soft limestone, screenings and sand." Each item was sloped to obtain a variation in the total thickness of base and pavement above the subgrade. Deflection gages were installed to record subgrade movements. The tests were reported in July, 1944.

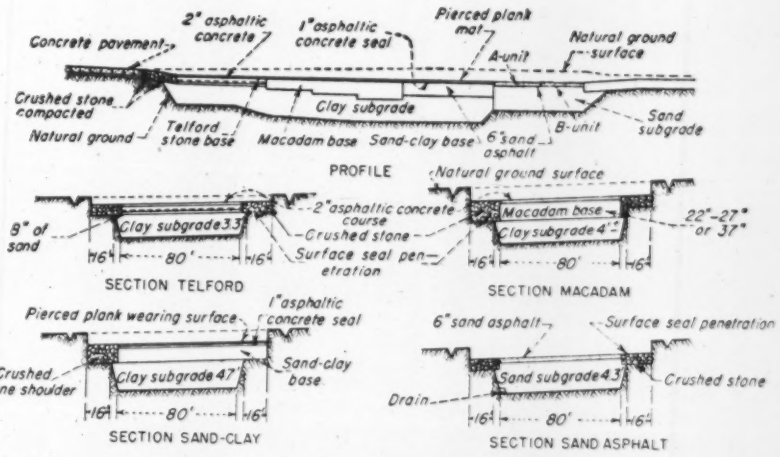


Fig. 2. Runway construction at the Marietta airfield introduced two major variations from previous test runways: rolled fill subgrades of borrowed materials and fills built in trench or confined fills.

The Marietta test runway is shown by Fig. 2. The test section is 270 ft. long and 80 ft. wide, the great width being provided to permit locked-wheel turns of B-29 planes. The individual sections were: (1) Telford stone base and a 2-in. hot-mix asphaltic-concrete surface 60 ft. long; (2) three 30-ft. sections of waterbound macadam of different thicknesses and a 2-in. hot-mix asphaltic-concrete surface; (3) a 60-ft. length of sand-clay base surfaced with 1 in. of hot-mix asphaltic-concrete overlain by a standard steel pierced-plank landing mat, and (4) a 6-in. sand-asphalt surface 60-ft. long on a sand subgrade.

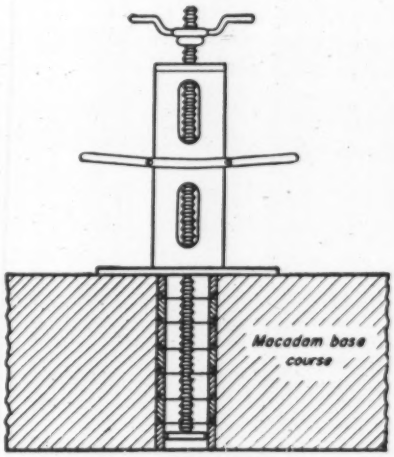


Fig. 3. Chances of disrupting macadam bond by digging or boring holes for deflection gages were avoided by building the base up around a pipe mold, which was afterwards withdrawn.

The test loads at Marietta were as follows:

Plane type	Wheel type	Empty (Pounds)	Loaded (Pounds)	Part loaded (Pounds)
B-24	Single	20,000	30,000	25,000
B-29	Dual	40,000	60,000	50,000

The tests were made with planes standing and towed with motors dead; planes standing with motors running; planes taxiing, and planes turning with locked wheels. Tests were also made with loaded bearing plates. The loading was both incremental and repetitional as shown in Table I.

Many advances made

The account of runway structures and loadings that has been given is but the barest outline of voluminous reports. It however brings out the fact of a progressing study of flexible-pavement runways. The successive installations show advance in structure, increase in variety of loads, increase in the variety of pavements brought under load and a greater range of subgrade characteristics. A study of construction methods emphasizes these facts.

Since runway construction at Marietta is the latest (1943) reported, the

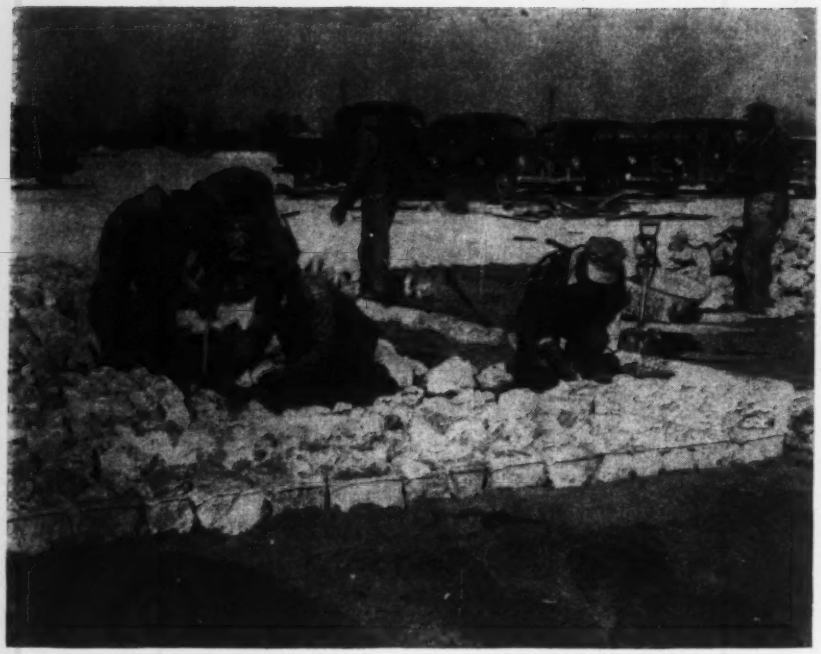


Fig. 4. A view not often seen in modern roadbuilding of hand operations in constructing telford stone base. Stone is shown before voids were filled and the stones were wedged tight by driven-in stone spalls and chinked by rolled-in stone screenings.

nethods and devices used are selected to illustrate general technique. The details given, of course apply specifically only to the Marietta operations but they also indicate the care and precision characterizing construction control at Stockton, Eglin and Barksdale. At all these test runways, it is to be observed, construction practice did not range beyond that which could be regularly exercised in any ordinary airfield construction operation.

Subgrade—The subgrade under all base and pavement was a fill of borrowed material built in trench as shown by Fig. 2. A fairly well-graded sand fill about 4.3 ft. deep was the subgrade for the sand-asphalt pavement. For the remaining pavements the subgrade fill was about 4 ft. of a plastic clay having a California bearing ratio (defined later) of about 4 percent.

The clay subgrade was scraper spread in 5-in. loose layers and compacted with six passes of a sheepsfoot roller. The fill was carried to 4 in. above grade, bladed down to grade and smoothed with five passes of a wobble-wheel roller. The sand subgrade fill was placed in 8-in. loose layers which were given 16 passes of a sheepsfoot-roller having a contact pressure of 400 lb. per sq. in., Fig. 1.

Sand-Clay Base—The sand-clay base was 26 in. thick composed of an artificial mixture of sand, clay and silt. The materials were blended by repeated windrowing and spreading. The mix was then placed in 8-in. layers compacted with 16 to 20 passes of the roller used on the sand subgrade.

Macadam Base—The three macadam sections were 23, 29 and 39 in. thick each inclusive of 2 in. of asphaltic-concrete paving. The macadam was $\frac{3}{4}$ to 3-in. crushed limestone and was bedded on 1 in. of screenings on the clay subgrade. Construction varied little from visual practice. The macadam was built up in 4-in. courses. The first four courses were not sprinkled to prevent water from getting to the clay subgrade, but the other courses were sprinkled and screenings broomed and rolled in using a 10-ton roller.

One special device applicable where deflection gages are installed is shown by Fig. 3. Holes for placing the gages were formed as the base was built up, by building up sections of pipe and molding the macadam around them. The bottom section of pipe had a welded-in disk, with a threaded hole in the center. When the base was completed the special jack shown was set up, the jack rod was screwed into the disk and the whole pipe mold was pulled out.

Telford Base—The telford base consisted of an 8-in. sand cushion on the subgrade on which on edge were telford stones 9 to 11 in. high and each not less than one-third as thick as it

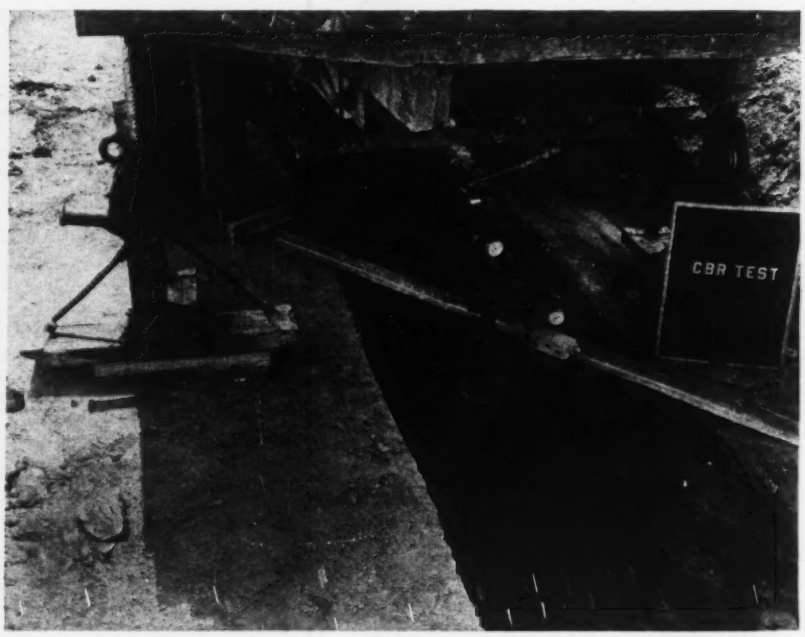


Fig. 5. Field in-place tests for California bearing ratio were made with a truck-mounted screw jack operating the piston through a proving ring.

was high. As completed, the base was about 16-in. thick, say 10 in. of stone and 6 in. of cushion.

The infrequent use in recent road-building of telford construction and also its complete failure under test makes its construction of special interest. The 8-in. sand cushion was compacted by six passes of a sheepsfoot roller, with a contact pressure of 210 lb. per sq. in., followed by six passes of a wobble-wheel pneumatic-tire roller. Surface compaction was then increased by sprinkling and rolling with a 7-ton tandem roller.

The laying of the telford stone was a hand operation, Fig. 4. The stones were set upright and fitted together as closely as possible. Stone spalls were driven into the larger voids and the surface was smoothed down by a 7-ton tandem roller. Screenings were added, broomed, sprinkled and rolled in. The density obtained was about 140 lb. per cu. ft.

Surfaces—Both the asphaltic-concrete and the sand-asphalt surfacing materials were processed in a commercial plant. The control and placing methods were those common to good construction with these materials.

Construction-control tests

Test control was the outstanding construction practice. All the common tests to determine the quality of the materials, (clay, stone, gravel, sand, asphalt and combinations of them) were conducted as a matter of course. In addition, facilities for all the modern soils-laboratory methods were available and were drawn upon as needed. The working tests finally most employed were those for water content, dry density and California bearing ratio (CBR).

The California bearing ratio (CBR) is a modulus of shearing resistance of soil, which is determined by comparing the bearing-strength value obtained by an arbitrary penetration shear test with the standard bearing value obtained on crushed rock (average of many samples). The standard is taken as 100 and the values obtained from the soil tests are expressed as percentages of the standard. The CBR value is the value used to determine runway flexible pavement and base thickness in the method of design used by the Army Engineers. (This will be discussed in Part II.) The CBR tests were the most-used construction control tests and tests to determine subgrade condition before and after the application of plane loads.

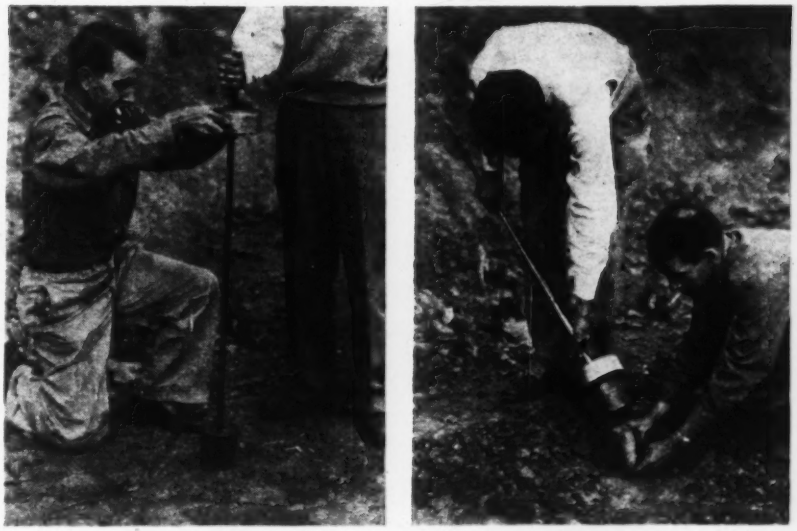


Fig. 6. A simple hammer device operated as shown provides in-place soil samples for determining water content, density and specific gravity.

California bearing ratio tests were made both in laboratory and field. Laboratory tests were made by compacting the material at a given water content and a given density in a 6-in. cylindrical mold. The compacted specimen was then penetrated by a 3-sq. in. piston at the rate of 0.05 in. per minute and load readings were

TABLE I—BEARING PLATE TEST LOADS EMPLOYED IN THE MARIETTA RUNWAY PAVEMENT TESTS.

(Three diameters of plates were tested with bolt incremental and repetitional loads)

Type of Test	10-in. Plate (Pounds)	20-in. Plate (Pounds)	30-in. Plate (Pounds)
Inc., max. loads	5,000 and 10,000	20,000 and 30,000	40,000 and 60,000
Rept. 10 cycles	0– 5,000	0–20,000	0–40,000
Rept. 10 cycles	0–10,000	0–30,000	0–60,000

TABLE II—SUBGRADE AND BASE CONDITIONS BEFORE AND FOLLOWING PLANE TESTS, AS SHOWN BY TESTS FOR WATER CONTENT, DENSITY AND CALIFORNIA BEARING RATIO.

Item	Material Tested	Water Content Percent	Density Lb./cu. ft.	CBR Percent
Thin macadam	Clay Subgrade			
	Before (Average)	30	90	5
	After (Average)	29	92	4
Med. macadam	Clay Subgrade			
	Before	32	93	3
	After	31	92	4
Thick macadam	Clay Subgrade			
	Before	29	85	7
	After	30	92	3
Sand-clay	Clay Subgrade			
	Before	31	92	5
	After	30	94	3
Sand-clay	Sand-Clay Base			
	Before	10	122	35
	After	11	127	12
Sand-asphalt	Sand Subgrade			
	Before	10	110	24
	After, at surface	8	118	28
	After, below surface	8	108	21

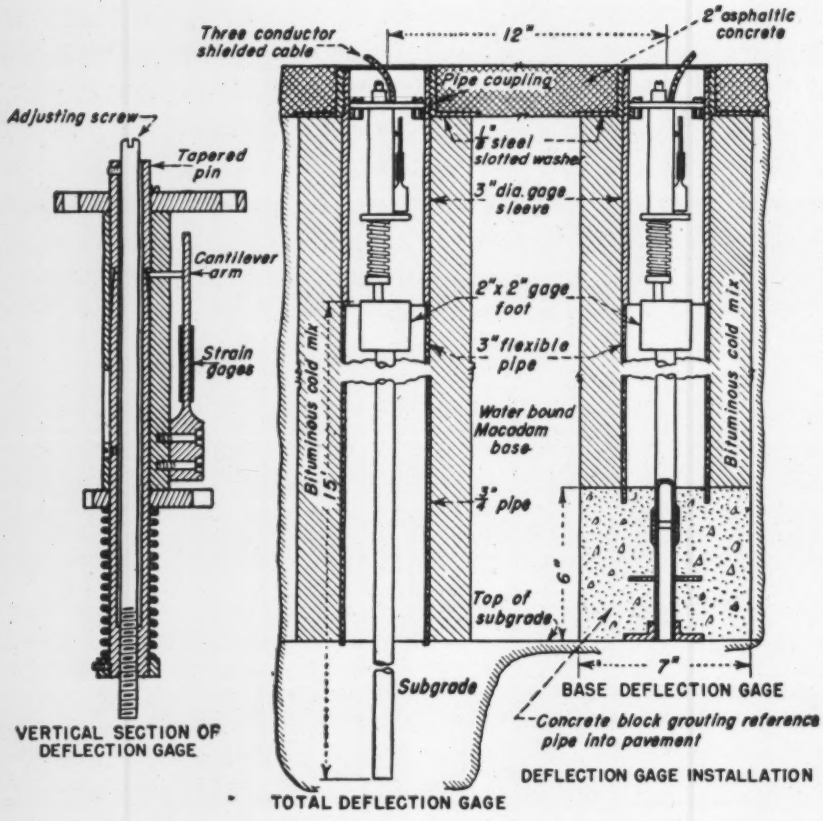


Fig. 7. Deflection gage and methods of installing gages in couples, one to record surface deflections and the other to record base compression, from which the subgrade deflection may be determined.

taken at determined depths of penetration. Field in-place tests for CBR values were made with a penetration device Fig. 5, mounted on a truck using the same piston area and penetration speed as in the laboratory test.

Density and water content determinations were made in the laboratory on undisturbed CBR samples. The operation of the sampling device is shown by Fig. 6. Briefly, the sampler is a hand-operated hammer-type device that drives a thin-walled steel cylinder into the soil. The cylinder is inserted in the driving head, bearing against a shoulder, and is held in place by sidewall friction. The cylinder is driven as shown until the soil protrudes from the upper end. The driving head is then freed and the cylinder, with its contents, is withdrawn from the ground and the ends of the sample are bladed off flush with the cylinder ends. Wet density is determined after which a part of the sample is used to calculate moisture content and specific gravity. Dry density is then computed from moisture content and the known volume of the sample. This method was used only for density determinations of fine-grained soils. The density of coarse-grained materials was determined by the dry-sand method.

Table II indicates the base and subgrade conditions secured by the control tests.

Deflection and pressure devices

At Marietta three lines of deflection gages were installed to provide a duplicate gage for each plane (B-24 and B-29) for checking purposes. It was desired to have one line of gages common to the two planes and one independent line for each plane unaffected by consolidation under traffic of the other planes. The deflection gage and the method of setting the gages in couples are shown by Fig. 7.

The activating element of the gage is the tapered pins moving up and down with deflection. Movement alters the bending stress in the cantilever arm and changes in electric resistance in the strain gages. These resistance changes in turn are recorded by oscillographs so as to be scaled in fractions of an inch.

As installed, one gage was to measure total deflection and the reference pipe was driven to good bearing about 16 ft. below the surface of the pavement. The other gage was installed to measure compression of the base and the bottom of the pipe was grouted into the pavement base. The difference between readings of the gages furnished a measure of subgrade deflection.

To measure pressure, four pressure cells were set at different depths in the clay subgrade under the medium-depth macadam base and four were similarly placed in the sand subgrade. A 12-in. cell 1 in. thick was used. It had a steel diaphragm to which a strain gage was attached. Pressure on the cell cover-plate was transmitted to the diaphragm through an intervening oil-filled chamber. The stress on the diaphragm registered as an electrical resistance change on the strain gage which, recorded by oscillograph, could be scaled.

Action of gages and cells under test loads required a considerable system of electrical wiring, amplifiers, oscillographs and other devices.

The information from which this article has been prepared is the report, "Certain Requirements for Flexible Pavements for B-29 Planes" by the U. S. Waterways Experiment Station. This report was prepared as a result of a study requested by the Headquarters, Army Air Forces. The study was conducted by personnel of the Embankment, Foundation and Pavement Division under the supervision of W. J. Turnbull, chief of the division. The Marietta tests, which furnished the major part of the data for the study, were conducted under the supervision of J. M. Griffith who prepared this part of the report. The analysis of the data and the application to requirements for B-29 planes were made by W. K. Boyd and Charles R. Foster. Gerard H. Matthes was director of the experiment station during the study. Personnel of the Engineer Board, Ft. Belvoir, Va., of the office of the Chief of Engineers, Washington, D. C., and Headquarters, Army Air Forces, Washington, D. C. assisted in planing and conducting the study.

A summary of the test results is given in Part II of this article, which will be published in a subsequent issue.

Salvaging a 27-Year Old Concrete Pavement

***Contents in Brief**—A plain concrete pavement built 27 years ago by the Delaware State Highway Department has been modernized by increasing the width of the slab with portland-cement concrete and decking the entire roadway with 3 in. of hot-mix asphaltic concrete. Placing of the portland cement concrete was expedited by the use of a paver that traveled forward on the old slab as work advanced. Results of the construction are so promising that contracts have been awarded for 34 additional miles of similar work.*

To SALVAGE the first portland-cement concrete highway pavement it built, the Delaware State Highway Department increased the width of the 20-ft. slab by 4 ft. and surfaced both the old and new pavements with asphaltic concrete. This construction, which is considered typical of much of the immediate postwar program planned for Delaware, resulted in a finished roadway expected to require minimum maintenance.

The Delaware highway department was organized in 1917 and the next year it put down its first concrete pavement between Dover and Smyrna on what is now U. S. Highway 13. Although the alignment of that highway was excellent, the original 16-ft. width of the old pavement was much too narrow, and in 1927 it was increased to 20 ft. by adding 4 ft. of concrete along one side.

In 1934 a two-lane 20-ft. wide parallel pavement separated from the old slab by a sodded parkway 50 to 70 ft. wide was constructed to accommodate the north-bound traffic. This work completed a 45-mi. highway between Dover and Wilmington—one of the longest, if not the longest, divided highway in the country at that time.

In recent years the 20-ft. width of the old pavement on this divided highway was found to be too narrow. To correct this condition, a contract to widen and surface 8.6 mi. of the old slab was carried out late last year at a cost of $168,000.

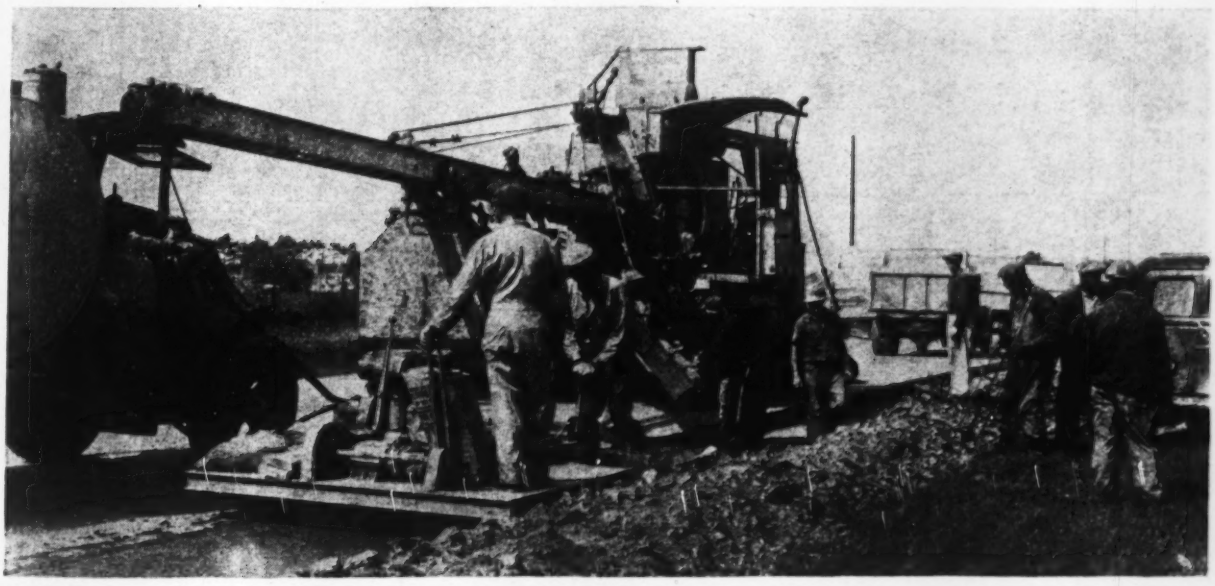
A 4-ft. increase in width, making the overall width 24 ft., was considered sufficient. Construction of a 4-ft. addition along one side rather than adding 2 ft. at either side was decided upon, since this method has been found to be most economical. Also, less trouble from movement of the new slab is expected with a 4-ft. addition.

No decision has been made as to when the north-bound pavement will be widened. Being of more recent construction, it is in less need of resurfacing or other rehabilitative procedures.

Decking considered necessary

The old pavement consisted of a 6-8-6-in. slab free of reinforcing and built without construction joints. Despite its age the old concrete was in relatively good condition and its replacement was considered unnecessary. Lack of expansion and contraction joints in the pavement contributed greatly to the slab's excellent service, according to W. W. Mack, for many years chief engineer of the Delaware department.

In anticipation of increased traffic, which includes the many heavily loaded



Concrete for constructing the 4-ft. addition along one edge of existing slab was supplied by a 27E single-drum paver traveling on the old pavement. As the mixer moved forward it pulled the water tank at the left.

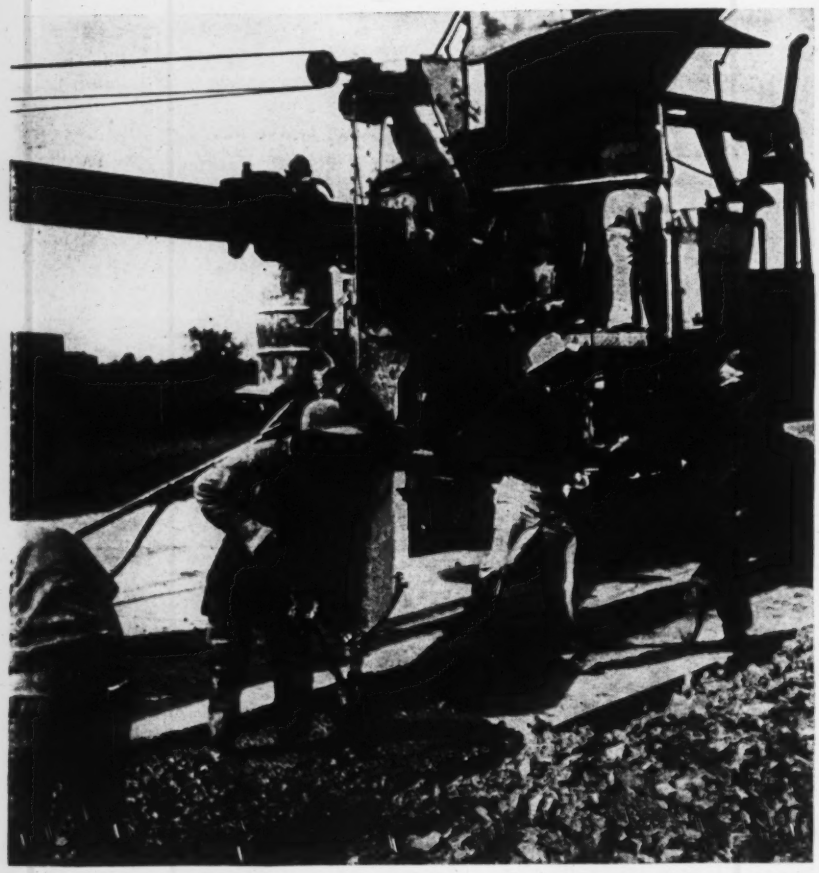
trucks now using Delaware highways, it was decided that the small number of badly cracked areas should be replaced with new concrete and that a "top" should be added for the entire width of the widened slab. This investment was considered to be warranted in view of the type of completed roadway to be provided and the importance of Route 13 in the inter-state highway network.

Once it had been decided that the old slab need not be torn out, detailed studies were made to determine whether it would be best to widen and deck the old slab with portland-cement concrete or to use asphaltic concrete for this work. The final decision was to specify portland cement concrete for the widening, which would make the bearing characteristics of the entire slab uniform, and to put down a "top" of hot-mix asphaltic concrete. Calculations showed that the latter type of surfacing would cost about 30 percent less than portland-cement concrete.

Excavation for increasing the width of the pavement was done with a motorized patrol grader. The trench was made 5 ft. wide, which was sufficient to provide room for the installation of the steel forms employed.

A concrete with an average compressive strength of 5,000 psi. was used for the widening work. The mix was as follows: Ordinary portland cement, 564 lb.; sand, 1,215 lb.; crushed stone aggregate, 2,202 lb. and water, 5.5 gal. per bag of cement.

For the patching work, which consists of considerably less than 5 percent of the pavement area, a richer mix was used. It consisted of: Ordinary portland cement, 647 lb.; sand, 1,073 lb.; crushed stone aggregate, 2,160 lb.; and water, 5.5 gal. per bag of cement. By use of the richer mix, traffic was permitted to travel over the patched areas sooner than would have otherwise been possible, the patching work being completed several days ahead of the widening and surfacing operations.



The concrete was delivered in the forms by a chute attached to the mixer and equipped with a crank to permit any necessary adjustment.

Although the use of central-mix concrete was considered, the contractor chose to mix the concrete on the job with a 27E single-drum paver. This unit traveled on the old slab, which was closed to traffic by requiring both north and south-bound traffic to use the two-lane slab normally used only by the traffic traveling northward. The concrete was chuted directly into the trench, the mixer moving forward as work progressed. With this method of placing, nearly 3,000 ft. of the new slab, which is 8 in. thick and unreinforced, was constructed daily.

A gasoline-powered finishing machine riding on the edge of the old slab and on the steel forms followed closely behind the mixer. Final finishing was by hand floating, and curing was accomplished with a 2 percent solution of calcium chloride and wet burlap.

Hot mix used for deck

Cold mix asphaltic concrete had been used previously as a top on a somewhat similar project with fair success. However, on the work here described it was decided to put down 3 in. of hot-mix asphaltic concrete applied as a $1\frac{3}{4}$-in. base course and a $1\frac{1}{4}$-in. wearing course. Use of the hot mix is expected to result in a tighter deck at about the same cost as the cold mix.

As a first step in adding the top, 0.10 gal. per sq. yd. of RC-1 asphalt was applied at a temperature of 135 deg. F. This material was allowed to cure for at least a day before application of the base course.

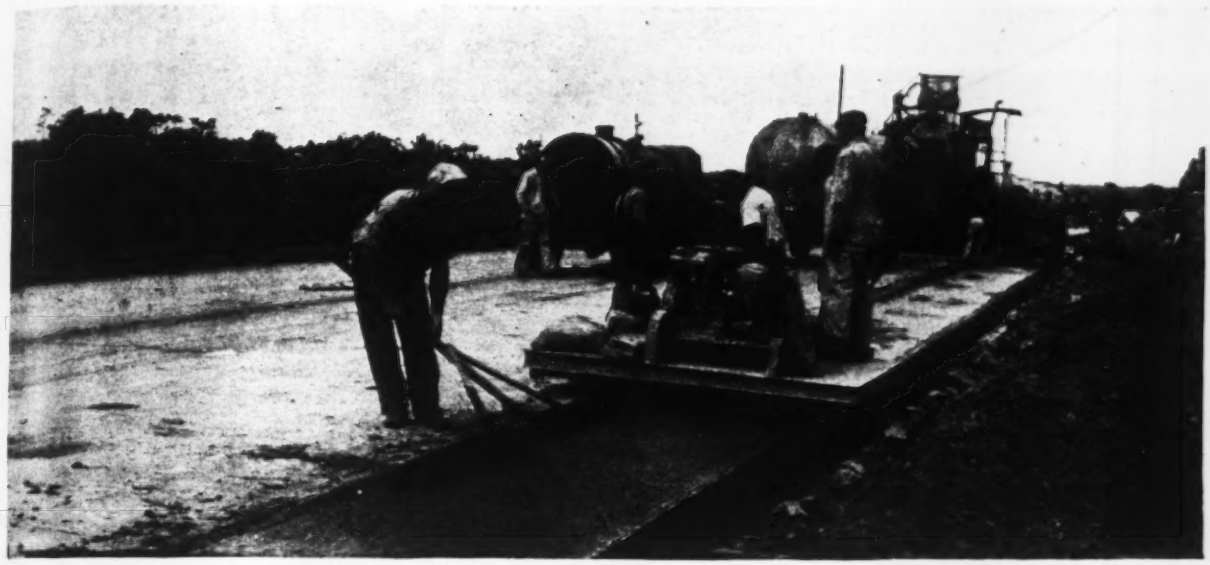
In preparing the base the aggregate used was crushed granite rock meeting the following specifications:

Sieve size	Percent passing
$1\frac{1}{2}$-in	100
1-in.	95 to 100
$\frac{1}{2}$-in.	45 to 75
No. 4	25 to 45
No. 200	5 to 10

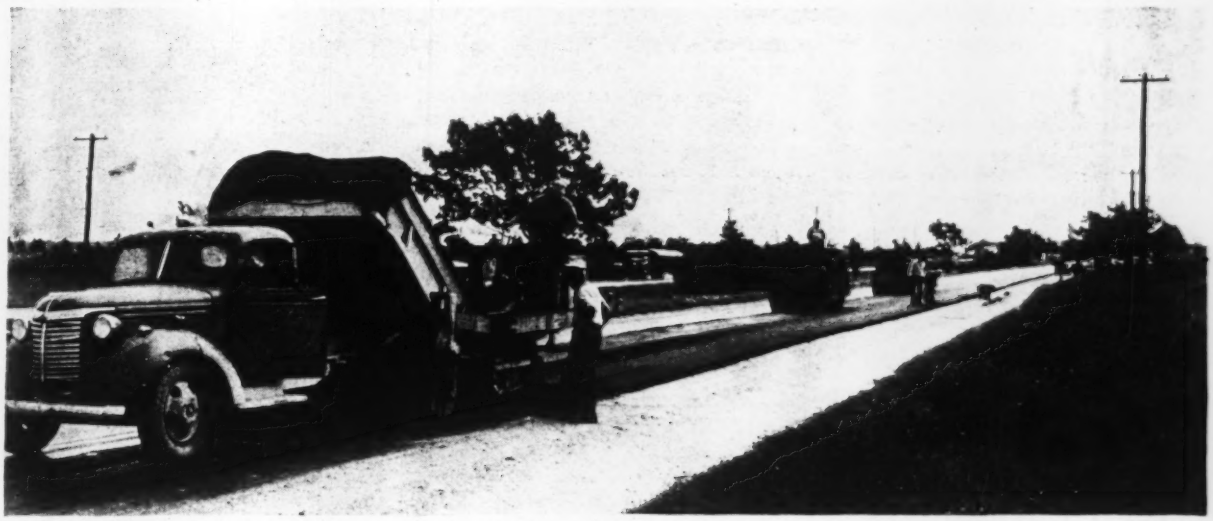
The aggregate was mixed with 4.5 to 7.0 percent of 85 to 100 penetration asphalt, 5 percent generally being used.

General procedure was to pave one lane at a time for a full day and then to go back and put down the other the next day. The base mix left the plant at a temperature of 275 to 300 deg. F. Rolling was first with a 10-ton tandem-wheel roller, followed by an 8-ton similar unit that did the finishing work.

Addition of the wearing course followed closely behind the base course.



Machine finishing of the added pavement was done with a small finisher riding on the old pavement and the side form. Hand floats were used for the final operation before curing with wet burlap and 2 per cent calcium chloride solution.



As a last operation in salvaging the old pavement, a 3-in. hot-mix asphaltic concrete top was put down, which is expected to result in a roadway requiring little maintenance for several years even under heavy modern trucking.

In this work the granite aggregate had to meet the following gradation:

Sieve size	Percent passing
½-in.	100
⅜-in.	80 to 100
No. 4	50 to 65
No. 10	30 to 45
No. 20	20 to 30
No. 40	15 to 25
No. 80	10 to 20
No. 200	5 to 10

The bitumen consisted of 6 to 8 percent of 85 to 100 penetration asphalt, the lower amount generally being used.

The wearing course was put down at a temperature of from 290 to 325 deg. F. Rolling was with the same equipment as that used in applying the base course.

Good results obtained

The finished highway has excellent riding qualities and low maintenance costs are anticipated. All indications are that the investment should pay large dividends. Engineers of the highway department found the methods described sufficiently satisfactory that four other contracts for 34 mi. of similar work in southern Delaware were recently awarded and 23 additional miles will be started this summer.

For the highway department, of which W. W. Mack is chief engineer, John B. Carson was division engineer in general charge. George & Lynch, Wilmington, Del., represented on the job by Joseph Pennington, was the general contractor. For the Public Roads Administration, which aided in financing the project, J. F. Sullivan is state engineer for Delaware.

Wellpoints Used to Compact Sand Fill

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Field Engineer, Griffin Equipment Co. Inc.
Hammond, Ind.

***Contents in Brief**—A wellpoint system supplied water for flooding a sand-backfilled area to be occupied by buildings and then dewatered the fill. This procedure compacted the fill to a specified 95 percent of the maximum dry density and greatly increased the bearing capacity of the soil.*

A UNIQUE METHOD of compacting loose sand fill by flooding and subsequent dewatering was used in the preparation of a building site for the erection of a number of laboratory buildings at Hammond, Ind., for the Standard Oil Company of Indiana.

The building site, roughly 900x1,300 ft., was originally a marshy area containing numerous small borrow pits that in recent years had been filled with debris of all kinds.

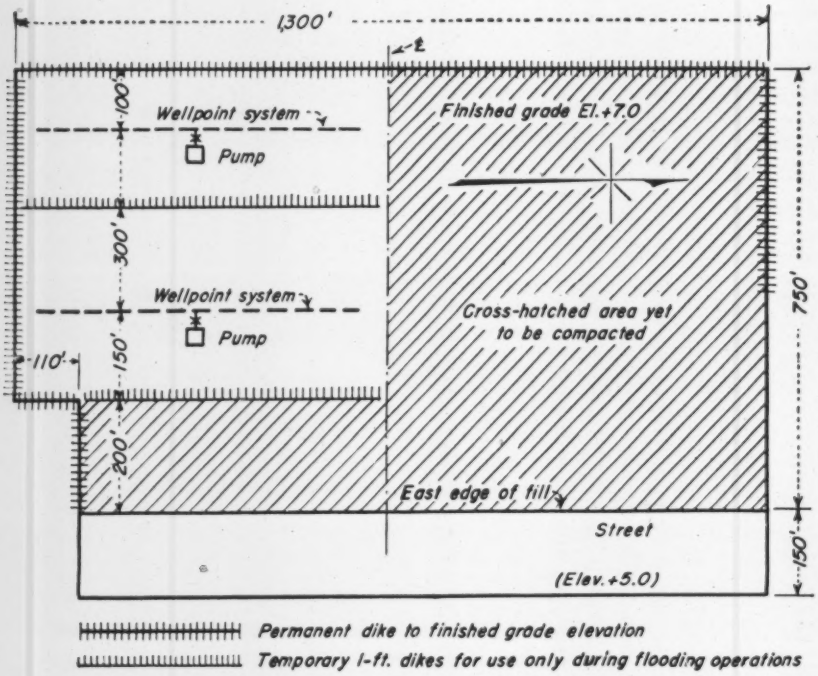
Specifications by the designers and supervising engineers for the building project called for the dewatering and removal of all muck and other deleterious matter from the area and backfilling with clean sand to a specified elevation, resulting in an average fill of 5 ft. over the entire area. After the fill had been placed, it was to be compacted by wellpoint dewatering to give a dry density of 95 percent of the maximum dry density of the fill material, as determined by laboratory compaction tests.

The ground sloped gently downward from a street on one side of the site, and the elevation of the fill was to be approximately 2 ft. above this street. Muck and topsoil on the area averaged 1 to 2 ft. in depth. Several of the old borrow pits had been backfilled with debris to a depth of about 11 ft.

The higher ground close to the street was excavated with tractor-drawn scrapers. Refilled borrow pits, containing miscellaneous debris, were excavated with diesel shovels. The lower marshy area was demucked with draglines and bulldozers. At the start of the excavation all spoil that could be used was placed as a dike to the height of the finished grade around three sides of the area.

As excavation progressed, surface water on the marshy sections was removed by ditches at random locations draining to sump pits at the dike where one 8-in. and one 4-in. centrifugal pump disposed of the water. One particularly wet area about 250x350 ft. in size, which was covered by 18 in. of water, was dewatered with a wellpoint system consisting of 50 wellpoints, 300 ft. of 6-in. header pipe and one 1,700-gpm. wellpoint pump.

Sand fill was hauled to the area in 8-cu.yd. trucks, end-dumped and leveled with bulldozers to final grade in one lift in all but one portion of the area where a maximum fill of 11 ft. was necessary. Here the fill was placed in lifts and compacted after each lift. To facilitate traction for trucks, fill was continually wetted down by spraying with water pumped by two high-pressure two-stage jet pumps.



Sand fill in this area was increased in density from 87.5 to 97.5 lb. per cu. ft. by flooding for 96 hr., and dewatering by wellpoints. The area to support buildings already is compacted; cross-hatched area is to be compacted for future use.

Flooded to 6 in. depth

Specifications for compaction of the fill with wellpoint dewatering equipment made no reference to the amount, capacity, nor location of equipment to be used. They did, however, specify minimum operation requirements, namely, that the areas to be compacted were to be flooded to a depth of not less than 6 in. above the highest point in the fill and that this depth of water was to be maintained for not less than 96 hr. with the wellpoint system in continuous operation. After that

period the discharge from the pumps was to be diverted and the fill dewatered to 1 ft. below the original groundwater level.

Compaction was completed on about two-fifths of the fill, an area about 550x700 ft. before operations had to be suspended early in December because of freezing weather. Compaction was accomplished by the installation of two wellpoint systems on this area. Each system consisted of 100 wellpoints attached to 12-ft. riser pipes 600 ft. of header pipe and one 1,700-gpm. wellpoint pump. The planned effective area of each wellpoint system was 300 ft. in width.

After compaction operations were completed, load tests showed a settlement of 0.13 to 0.19 in. at 8,000 lb. per sq. ft. as compared to a settlement of 0.5 in. for fill in place before compaction. The dry density of the soil before compaction was 87.5 lb. per cu. ft. and about 97.5 lb. per cu. ft. after compaction.

Supervision

Holabird & Root, Chicago, Ill., are the designers and supervising engineers, and their representative on the site is W. W. O'Connell. All compaction tests are under the supervision of Geo. Sawyer, representing the Robt. W. Hunt Co., Chicago, Ill. The general contractor for the excavation and filling operations is the Central Teaming & Construction Co., Chicago. All their work was performed under the direct supervision of A. J. Tadrowski, president of this firm.

Wellpoint dewatering equipment was furnished by the Griffin Equipment Co., Inc., Hammond, Ind., midwest branch of the Griffin Wellpoint Corp., New York City. Wellpoint equipment recommendations and installation planning were handled by the author. Neill N. Payne is manager of the Griffin Equipment Co., Inc., and in general charge of the wellpoint operation.

Overflow Structure in Trunk Sewer Diverts Storm Water to Beach

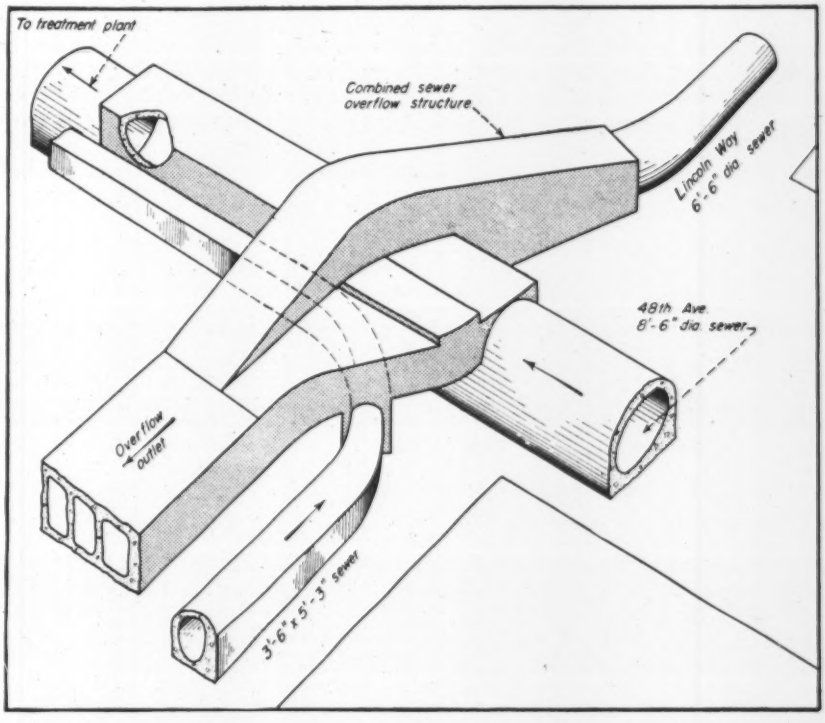
A COMBINED-SEWER overflow structure, shown diagrammatically in the accompanying sketch, is being built for the City of San Francisco at the intersection of Lincoln Way and 48th Ave. Shown in the drawing is the three-compartment overflow sewer designed to take excess storm water from the incoming sewers on the right. The excess flows to an outlet structure on the beach; the remaining flow goes, through the sewer shown at the upper left, to the Richmond-Sunset sewage treatment plant.

Until the reinforced concrete overflow structure is completed, the Richmond Sunset plant must continue to take the entire flow of the sewers shown, which carry almost all of the storm drainage and sanitary flow from the heavily populated south-western portion of the city. Plans are underway for doubling the capacity of the treatment plant. However, it still will not be able to handle all of the storm flow effectively. Accordingly, this overflow structure is being built a few hundred feet from the treatment plant so that there will be a limit to the flow going to the plant.

Overflow compartments on each side of the Lincoln Way line will, during storm flow, permit excess sewage to flow into the compartments shown in the center and on the left of the overflow outlet line. Excess flow in the 48th Ave. line will overflow to the section on the right of the three-compartment outlet line running to the sea.

The outlet, a few hundred feet from the overflow structure, is located on the beach just below the high tide line, where it is subject to sanding up. Flushing facilities, provided at the outlet by a connection with the city's water supply, will be operated so that excess storm drainage will flow freely onto the beach and into the ocean. This storm flow will contain sanitary sewage. However, the quantity of such sewage will be small as compared with storm flow and no pollution problem is anticipated.

The small line in the foreground of the drawing was in place before the new work started and there is no connection between the two.



During periods of high runoff due to storms the load on the treatment plant is reduced by permitting part of the flow in the Lincoln Way sewer and 48th Ave. sewer to spill over into an overflow outlet to the ocean.

Paraguay Sewer Built of Timber And Floated Into Place

AN OUTFALL SEWER for the city of Asuncion, Paraguay, was built of native timber on greased ways on shore and then floated to the desired location, where it was lowered into a trench and covered with quarry stone. By following this procedure several months were saved in constructing the sewer, which is about 30 in. in diameter and nearly 250 ft. long.

A wood-stave pipe was selected because of the unavailability of steel or cast iron pipe, or equipment with which to lay the concrete pipe originally proposed. Advantage was then taken of the situation whereby native workmen could produce the wood staves in local shops and a timber pipe could be placed with the equipment available. Use of other materials would have required importation of equipment not available locally.

Fig. 1. Outfall sewer for Asuncion, Paraguay, which was fabricated of 2-in. thick timber staves cut locally. Timber was used to overcome a shortage of steel or cast iron pipe and a lack of equipment for handling concrete pipe.

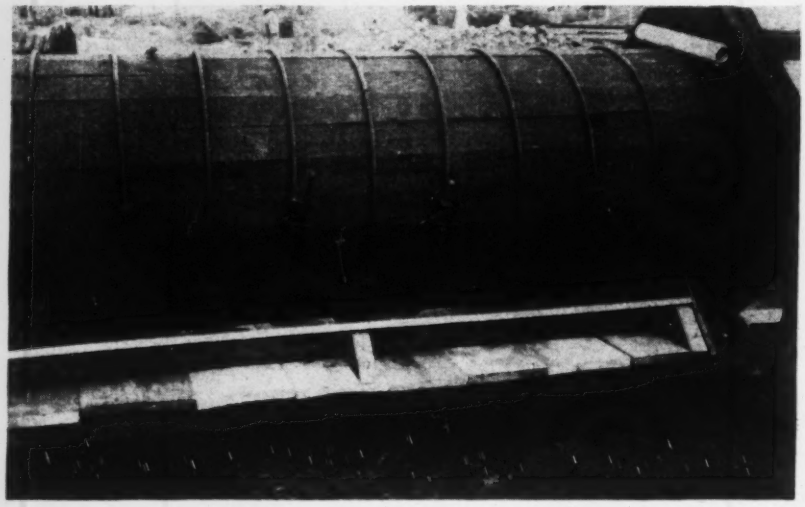


Fig. 2. To provide sufficient weight to sink the pipe in final position, concrete counterweights secured to the steel hoops of the pipe were added. The forms were in place for casting the counterweights when this picture was taken.

Wood staves 2 in. thick made of Spanish cedar having a specific gravity of 0.65 were used, which resulted in the fabrication of pipe that would float. Wooden flanges 4 in. thick were spaced every 8 ft. to provide additional resistance against crushing when backfill was added over the pipe. A concrete counterweight designed to give the pipe a submerged weight of 20 lb. per ft.—and thus overcome its buoyancy—was attached to the conduit by securely wiring the steel reinforcing bars of the counterweight to the steel hoops (Fig. 2). A space of 8 in. was provided between the wooden stiffening flanges and the ends of concrete counterweights to permit a certain amount of flexibility without danger to either the pipe or the counterweights.

The pipe was constructed on greased ways laid at right angles to the river bank in the only space available for this work. This layout necessitated later towing of the completed pipe to the desired location. The ways had a length of about 150 ft., which made it necessary to move the forward part of the pipe into the water before completing the last 100 ft. The pipe was shifted with a 3-part block and tackle with power supplied to the free line through a cathead mounted on the rear wheel of a 1½-ton truck. The conduit with its counterweights had a total deadweight on the ways of more than 7 tons.

Pipe supported on five floats

At the end of the ways the pipe was raised and transferred to floating equipment consisting of pairs of rowboats or floats of four barrels each (Fig. 3). Each float carried a truss upon which was mounted a capstan for raising and lowering the pipe. Five such floats were sufficient to support the entire load in the water. The pipe was built at some distance from final location, and its movement downstream into position was accomplished with regular floating equipment used during fabrication of the pipe.

The trench for the pipe was excavated with equipment furnished by the Paraguayan Navy. The conduit was towed into position as a complete unit and tied up to the dredge and a barge anchored at one side of the trench. Before the pipe was lowered into the

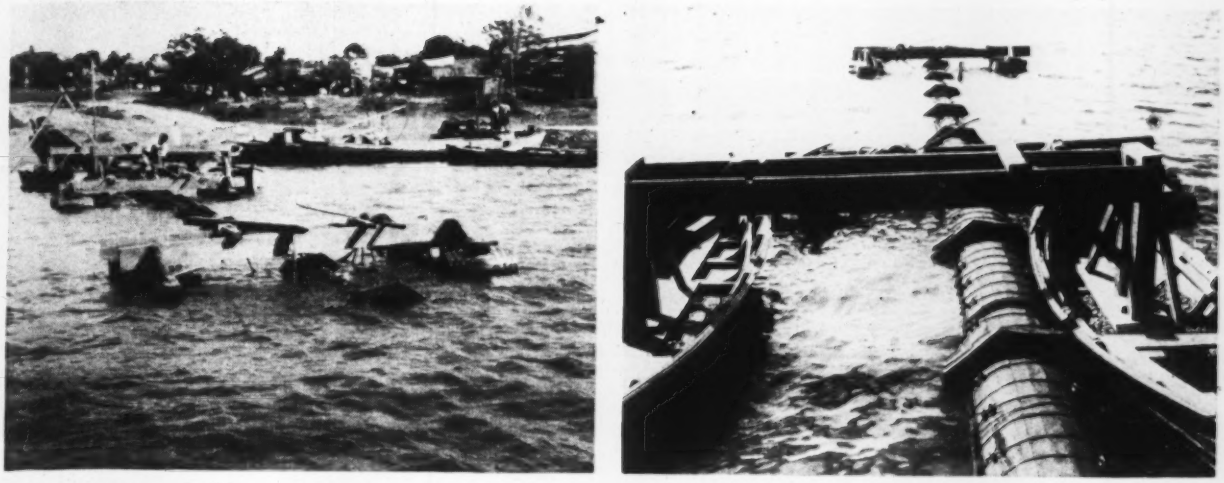


Fig. 3. Outer end of pipe was supported on a pair of floats, each consisting of four barrels. Right: A pair of boats joined by a timber truss was another method of supporting the pipe. The conduit had not been suspended from the truss in the foreground when this picture was taken.

trench a diver of the Paraguayan Navy inspected the excavation and alignment of the pipe. Once the pipe was in final position, it was covered for protection with quarry stone transported by bottom-dump barges.

For the Office of Inter-American Affairs, Maj. John W. Greenleaf is chief engineer in Paraguay. At the initiation of the work Dr. Richard J. Plunkett was chief of party, being succeeded before the work was over by Dr. Jean F. Rogier.

Col. Harold B. Gotaas is president of the Institute of Inter-American Affairs, and Clarence I. Sterling, Jr., is chief engineer of the health and sanitation division, under whose direction the work was conducted.

Fig. 4. In transferring the pipe from the skids to the floats capstans were used to raise the conduits. Note concrete counterweight cast on the bottom of the pipe.

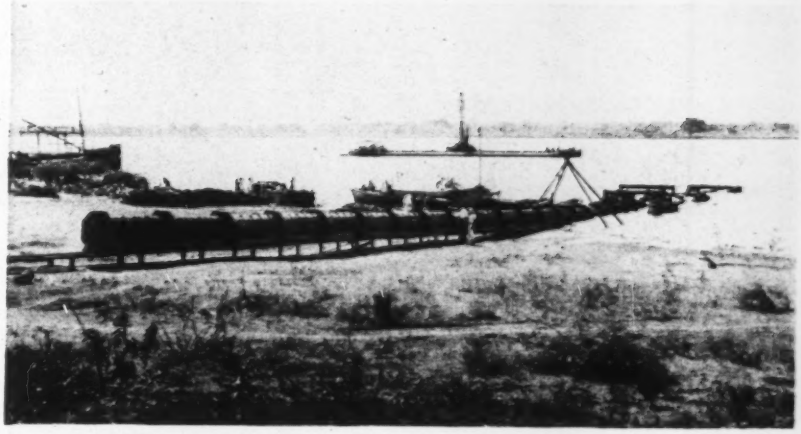


Fig. 5. Once the entire 250-ft. length of the sewer was completed it was pulled into the water with a block tackle with power from a truck.

Shooting Concrete Into Walls Cuts Lumber Use and Labor Costs

***Contents in Brief**—Undertaken as an expedient for overcoming the current lumber shortage, a West Coast contractor has found that building walls with gunite shot against a single outside form has possibilities for use under more normal circumstances to speed construction and cut costs.*

SAVINGS, estimated to be 20 percent or more in the cost of construction of concrete walls of buildings, have been brought about through the use of air-applied concrete by the Case Construction Co. of Los Angeles, San Francisco, and San Diego, Calif. Of particular importance is the fact that these savings are in terms of both lumber and labor at a time when these two commodities are costly, with the former leading the list of hard-to-get-items. In fact, it was an acute shortage of form lumber that prompted the Case company last fall to "shoot" concrete walls instead of pouring them.

While building walls with gunite is not a new idea, the results under current materials and labor shortages have been so satisfactory that this method may be employed in the construction of other West Coast industrial and commercial buildings.

As proof of the possibilities, Case Construction Co. points to some eighteen buildings with concrete walls erected in the Long Beach, Los Angeles, and San Diego area within the past year. Included are warehouses, supermarkets, automobile display buildings, radio studios, and other types of commercial structures, in addition to a theater with a seating capacity of 1,300 people.

In each of these buildings, construction followed very closely the design for poured concrete, taking some advantage of the allowance for the high compressive strength of gunite and minimum thickness of walls. Walls varied from 14 to 40 ft. in height and from 5 to 8 in. in thickness, depending upon the type of building and the city code in the area. Columns and beams were of various sizes, depending upon the design of the building and the load to be carried.

Fig. 1. Shooting a sand and cement mixture against a single wall form to make a reinforced concrete wall for a large building. The beam is "shot" to wall thickness, then a soffit form is placed as a line for the bottom and the beam is completed.

Gunite construction is simple

Steps in the building of concrete walls with gunite are simple. First, a footing is poured in the conventional manner, with steel dowels extending upward to be tied in with the wall reinforcing. A single wood form is then erected on the *outside* surface of the wall area (the gunite is shot from the inside). The building of only one wood form instead of two naturally results in appreciable savings in lumber, labor, and time.

Actually, however, the savings in material and labor are even greater than this indicates because gunite uses only sufficient water for the hydration necessary to bond chemically the cement and sand. There is no hydrostatic load as in the case of poured concrete. Consequently, the form backing does not have to withstand the same load as with poured concrete, and, therefore, can be built of lighter material.

Where the average concrete form requires 3 b. ft. of lumber for every square foot of form surface (or 6 b. ft. for both forms), the backing for the single gunite walls requires less than 1½ b. ft. per sq. ft. of form surface, or a saving of about 75 percent.

This saving is reflected in the use of fewer studs. Where 1-in. lumber is used, the studs are placed on 28-in. centers instead of the closer spacing required for poured concrete. Where plywood panels are used for backing (store fronts, panel effects, etc.), studs are placed on 30- to 36-in. centers. The

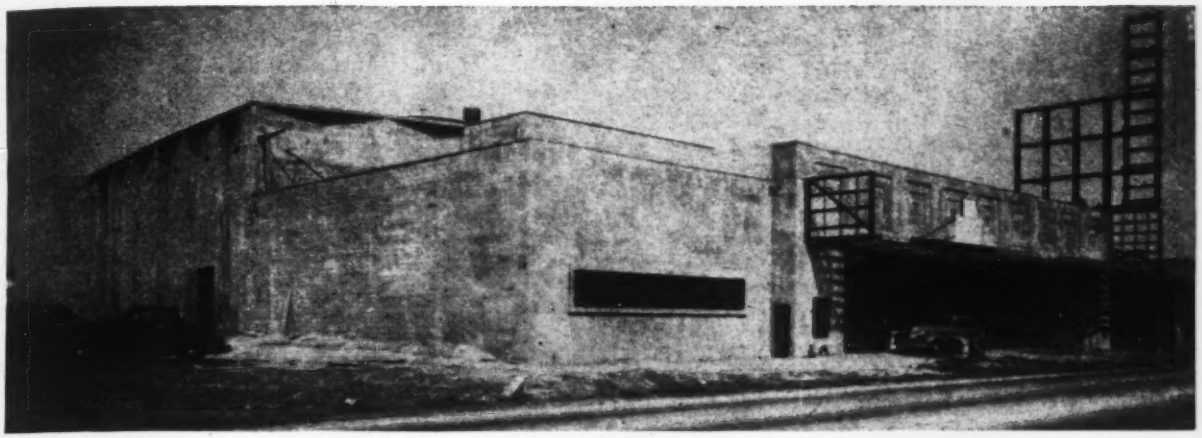


Fig. 2. Walls 40 ft. high for this theater are made of air-applied concrete built up against a single wall of ⅝-in. plywood at the front and on 1 x 6-in. sheathing along sides and rear.

heavy walers used on concrete form construction are practically eliminated. Light wales are placed in position at the bottom, halfway up, and at the top, except in cases of extreme heights, and the backing is braced with sloping 2 x 4's where necessary.

In building the form, every effort is made to have it strong enough to produce perfectly flat surfaces. Such a form is heavy enough to support the placement of gunite.

Scaffolding is required for shooting the gunite, but since a scaffold is needed by the electricians, plasterers, and other tradesmen for their work, the cost of its erection adds no disadvantage peculiar to the use of gunite.

A single curtain of reinforcing steel is usually used for a standard 6-in. wall. However, if an 8-in. wall is desired, two curtains of steel are used. Steel design conforms to that used for poured concrete.

Reinforcing steel is supported from the single wall backing. It is highly important that the steel be fastened very rigidly to eliminate vibration and insure proper embedment in the gunite. Column and spandrel beam steel are placed in position at the same time as the wall steel. Horizontal screed wires are stretched along the inside face of the wall so that the gunite may be screeded to assure uniform wall thickness and true alignment.

Shooting the concrete

The gunite is applied at a nozzle pressure of at least 30 psi. with water added within the specially constructed nozzle. One part cement to 4½ parts of dry sand by volume is used for the gunite. Typical of the sand is one project where 85 percent passes a screen with 8 meshes to the inch and 66 percent passes a 16-mesh screen with an overall fineness modulus of 2.91. Test cylinders, built up by gunite in a standard 6 x 12-in. mold, averaged 5,574 psi. when tested at 28 days while 3.9 x 5-in. cores cut from the wall tested 5,300 psi, corrected for size differential, however to 5,002 psi. This is well beyond requirements for a poured concrete wall and indicates possibilities of further economies in design.

The wall is shot from floor line to top of wall. The nozzle is held at right angles to the form surface and at a distance of 3 to 5 ft. When enclosing the reinforcing steel, the nozzle is held so as to direct the material behind the bars from both directions. Each side of the reinforcing bar is shot separately.

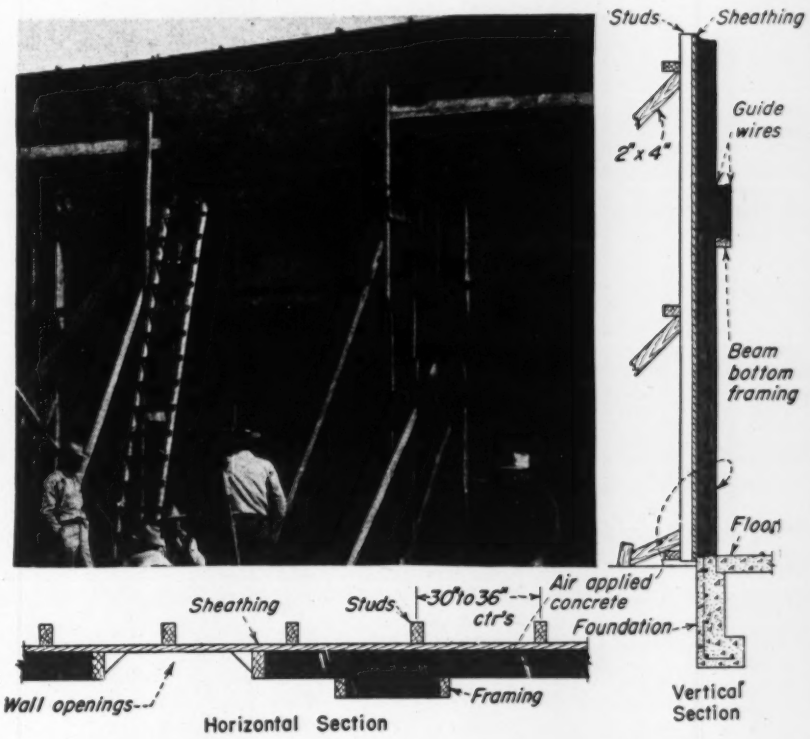


Fig. 3. Wall is built out to its full thickness, then beam, soffit and column framing are set to permit completion of the structural frame of the building.

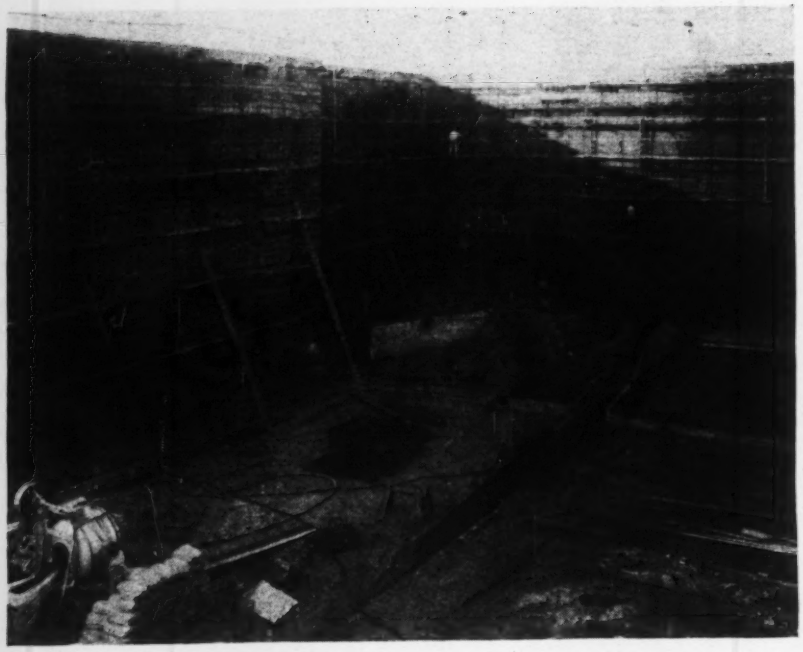


Fig. 4. No interior form is used and no ties through the walls. Scaffold required is utilized by other crafts after wall is built up.

Material that rebounds and does not fall clear of the work is blown off with an air jet. Great care is taken to make sure that no rebound material is allowed to accumulate on the work or in the crevices to be filled, since the rebound is principally sand and if not cleared away would form sand pockets in the wall.

The first application of gunite is shot from the inside of the building against the wood backing and brought out to the outside edge of the reinforcing steel. The second application is brought out to the full wall thickness and is then screeded off to guide wires to give perfectly straight walls. This screeding is accomplished by drawing a 4-ft. steel straight-edge along guide wires.

When successive layers of gunite are applied, each layer is lightly broomed before placing succeeding layers to insure a perfect bond. Walls 6 in. thick require placing of gunite in two layers. In walls of greater thickness, three or more applications of gunite are advisable.

Where columns are built, wood forms are placed on both sides and a soffit form is set under the spandrel beam. Columns and beams are shot to the required thickness, and screeded off to the forms. Champfer strips should preferably be used in column forms. After a few days, the single wall backing may be stripped away, but care must be taken to prevent rapid drying of the concrete.

In this type of wall construction, gunite is placed at an average of 15 to 20 cu. yd. a day. In average-sized buildings requiring 100 or more cu. yd. of concrete, the walls, columns, and beams are completed from start to finish in a little over two weeks' time.

Savings in both material and labor outlined earlier are somewhat reduced by gunite's being more expensive to place, yard for yard, than concrete is to pour. However, for the overall wall building job, from start to finish, the gunite process has in many cases resulted in a net savings of 20 percent or more in the total cost.

Added to this is speed of operation. The general contractor spends a week or ten days erecting the single form, the scaffolding, and placing the steel. His crew is then free to move on to other jobs. In poured concrete construction, contractor's crews generally are held on the job; while concrete crews are pouring one form, others are either removing forms from previously poured walls or erecting additional forms for higher walls.

In the Towne Theater, Long Beach, Calif., Fig. 2, the walls are 40 ft. high and contain over 1,100 cu. yd. of air-applied concrete. Forms were 1 x 6-in. sheathing with 2 x 4-in. studs at 24-in. centers. For the building front, $\frac{3}{8}$-in. plywood was used, backed by 2 x 4-in. studs on 30-in. centers. Reinforcing was a single curtain of $\frac{1}{2}$-in. steel at 12-in. centers each way. The walls of the theater were built complete in 60 days.

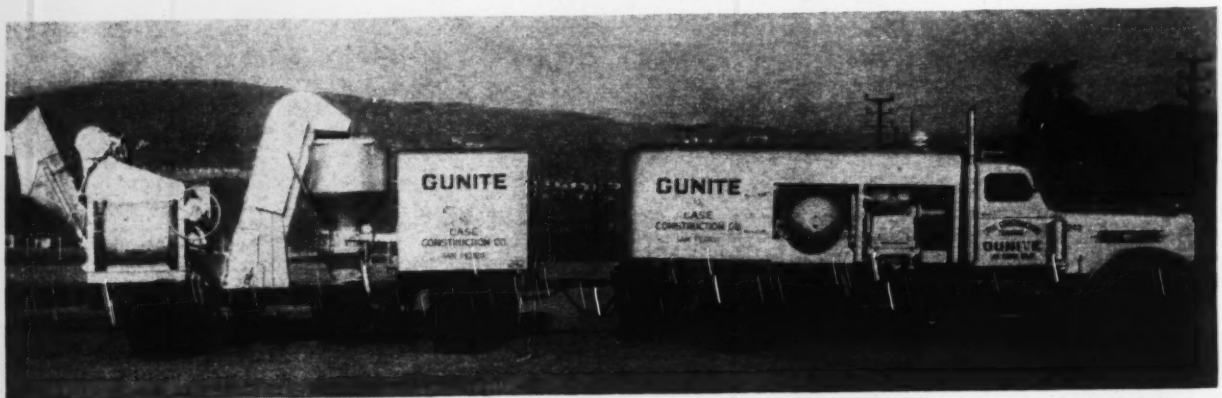


Fig. 5. Compressor, mixer and other special equipment required for air-applied concrete move to job in packaged unit.

Reducing Unknowns In Small Culvert Design

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Head, Department of Civil Engineering
Carnegie Institute of Technology, Pittsburgh, Pa.

INTEREST in rational design of small drainage structures has mounted with the realization of its importance and economic significance. However, there are still gaps in the data available to the engineer using this method of culvert design, and means by which some of these gaps can be narrowed or closed should be of interest.

The largest factors of uncertainty in the rational design of any drainage structure are the quantity of water and the rate of flow that must be handled. In the rational runoff formula $Q = CIA$, the area A is known. Also, the frequency and intensity of storm rainfall have been carefully documented ("Rainfall Intensity-Frequency Data," Miscellaneous Publication No. 204, U. S. Dept. of Agriculture) so that, for any region of the United States, these factors can be reasonably estimated.

However, for a given drainage basin, information about the time of concentration at any point along its water course and the coefficient C, the ratio of maximum rate of runoff to the average rate of rainfall for the time of concentration, is lacking or inadequately systematized. In aplying the so-called rational method of estimating runoff to a particular drainage basin, the time of concentration T_c and the runoff coefficient C are still essentially covered by specifications, by speculation, or by judgment. These uncertain factors, however, are amenable to simple, direct observation and analysis, one plan of study being as follows.

Culvert makes good stream control

A stream control—often the most expensive part of a small hydrologic installation—is already available in a well-constructed culvert, which needs only to be equipped with suitable recording gages (and possibly a low water control) to serve reliably as a stream gaging station. In case the culvert may be affected by backwater, so that it might operate submerged or partially submerged, a continuous water stage recorder with two pens—one recording the headwater elevation, and the other the tailwater elevation—could provide all the data necessary to estimate both the discharge through the culvert and the amount of water impounded above the culvert fill. Thus equipped, a culvert can provide a dependable means of determining runoff from its tributary basin.

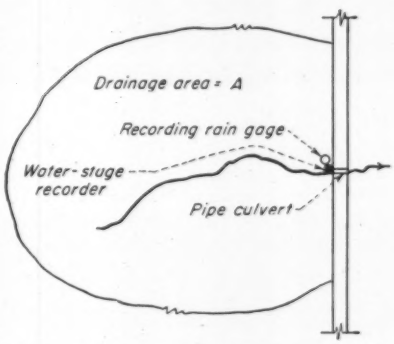


Fig. 1. For any small drainage area installation of a recording rain gage and water stage recorder at the outlet culvert will furnish valuable design data.

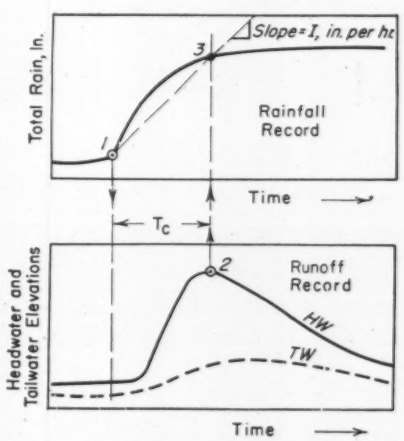


Fig. 2. Schematic analysis of rainfall and run-off records shows how time of concentration for the watershed and intensity of rainfall can easily be found.

A recording rain gage synchronized with the water stage recorder can provide data on rainfall occurrence and intensity, and an analysis of the rainfall and stream flow charts will show directly the time of concentration at the culvert.

The accompanying diagrams show one basis for analyzing rainfall and runoff data for a small drainage basin, with a view to establishing the time of concentration and the coefficient of runoff for a given storm. Fig. 1 shows the general layouts, Fig. 2 the rainfall and runoff records. As indicated schematically, the intense rate of rainfall begins at time T_1, and the peak rate of runoff occurs at time T_2. (In this hypothetical case the effect of pondage on an observed rate of runoff is neglected). The difference in time between T_2 and T_1 is T_c, the time of concentration for the tributary watershed.

In the rational runoff formula, $Q = CIA$, the term I is the average rate of rainfall in inches per hour for the time of concentration and is indicated by the slope of the secant on the rainfall record. The maximum rate of runoff can be determined from the records of the water stage recorder (Fig. 2) and the rating curve of the culvert. Although corrections for pondage are not considered in this hypothetical example, such corrections would offer only small complications to the analysis if the topographic data for the headwater pond were available.

Runoff coefficient easily found

Given, then, the maximum rate of discharge Q, the average rainfall intensity for the time of concentration I, and the area of the drainage basin A, one can calculate directly the coefficient of runoff C, which is the ratio of the maximum rate of runoff to the average rate of rainfall for the time of concentration. However the coefficient C may vary—whether as a function of storm intensity, antecedent conditions, cover and other factors—it can be analyzed further as additional data are accumulated.

Each storm as it occurs can be viewed perspectively in its long-term frequency pattern, since for each storm the time of concentration and the average rate of rainfall for the time of concentration can be determined from the rainfall record. With these two factors known, the probable frequency of that storm can be estimated by interpolation

between the generalized rainfall frequency-intensity data for the region. (A word of caution should be interjected here to obviate the errors in frequency estimation which may creep in for intense storms of much shorter duration than the time of concentration at the stream gaging station.)

Rating chart saves field work

If a pipe culvert is well constructed with a slope steeper than that required to overcome friction losses, if it discharges part-full at the outlet, and if the tailwater pool does not submerge the invert at the outlet, the quantity of water flowing through the culvert depends only on the diameter of the pipe and the elevation of the headwater pool above the inlet invert. The rating scale (Fig. 3) for calculating the flow of water through culverts under these conditions has been deduced from extensive laboratory studies and a few field measurements. In using this scale let Q be the discharge through the culvert in cfs., D the diameter of the culvert in ft., and H the elevation of the headwater pool above the inlet invert.

How the chart is used

To illustrate the use of this rating scale, calculate the discharge through a 48-in. pipe culvert if the headwater pool is 3.6 ft. above the inlet invert and if the flow is not affected by backwater. Then, $H = 3.6$ ft., $D = 4.0$ ft., and $H/D = 0.90$. Opposite $H/D = 0.90$ (on the left of the rating scale) read $Q/D^{2.5} = 1.85$ and compute $Q = 1.85 \times 4.0^{2.5} = 1.85 \times 4.0^{2} \times \sqrt{4.0} = 59$ cfs.

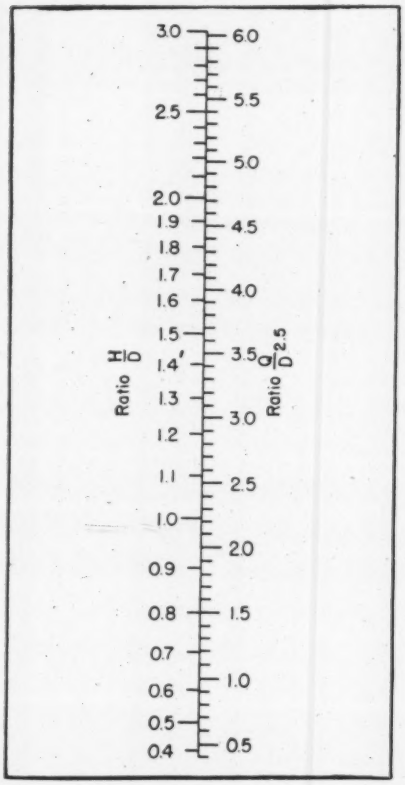


Fig. 3. Rating scale for computing flow through well-constructed pipe culverts discharging partly full with free outlet.

If the culvert is poorly constructed or if the flow through it is affected by backwater, the rating curves should be determined by stream flow measurements in the field. In any case a check by field measurements is desirable wherever possible.

Quantity production may reduce cost

Another important factor in culvert design is the one of economic analysis. Of several technically "adequate" drainage structures, the most economical one has the least sum of average annual maintenance cost, annual interest and amortization charges, and annual damage to property by backwater. A succinct statement of the elements of such an analysis and some of the general bases of selection from among competitive alternates should be exceedingly useful in an office manual. Such an analysis, supplemented by appropriate charts and tables to facilitate choices among the more common alternates, seems both practicable and useful. To be sure, the problem of economic selection of a small drainage structure does not differ fundamentally from the economic selection of any other engineering structure, but the element of "quantity production" of comparatively inexpensive units makes such a generalized analysis worthy of further consideration.

Washington Cities Fight Pollution with New Sewage Plant Program

As a result of the coordinated efforts of 42 municipalities and the Washington state government, a program has been developed for the construction of modern sewage treatment plants costing more than $20,000,000.

The American Public Works Association reports that the program is directed by the Washington State Pollution Control Commission created by the legislature last year with a $125,000 appropriation. The commission is composed of the directors of five state departments—conservation, fisheries, game, health and agriculture.

Since violations of the pollution control act constitute a "gross misdemeanor," the commission is equipped with a legal weapon that can be used to impose one-year imprisonment and fines up to $100.

Thus far, the act has been enforced without resort to prosecutions. Twenty-five investigations have been made since July and in all instances the investigator has determined the cause of pollution and has made specific recommendations for corrective action. Warning notices served by the commission have been complied with promptly.

The commission's progress report discloses that many municipalities have already submitted plans for the construction of disposal systems. Thirty-six Washington communities now have modern sewage disposal facilities. Of these, six have been rated inadequate by the commission, which has forwarded recommendations for improvements.

Intensification of Washington's pollution problems in Puget Sound is said to be due to industrial expansion during the war. Although Tacoma now dumps raw sewage directly into the sound, a $3,000,000 bond issue has been voted recently for new sewage facilities. In Seattle, conferences of city officials and commissioners have resulted in plans for pollution control construction.

Pollution control in the Columbia River is being effected by joint action of Washington and Oregon. On the Oregon side, Portland has started the Columbia river cleanup (*ENR* Jan. 24, vol. p. 139) with funds from a recent $12,000,000 bond issue.

Railroad Bridge Redecked for Vehicles

J. W. Green

Senior Bridge Engineer, Southern California Division,
California Division of Highways

CONVERSION to use by intrastate auto traffic of a cantilever railroad bridge more than a half century old was undertaken last year as a joint project of the state highway departments of Arizona and California. Completion of the project was expected early this year, but because strikes have held up production of steel, reconstruction will not start until late in the season.

The work consists of adding sub-floorbeams which will make necessary changes in the old system of floor beams and stringers and then add a 7-in. maximum-thickness reinforced concrete roadway slab.

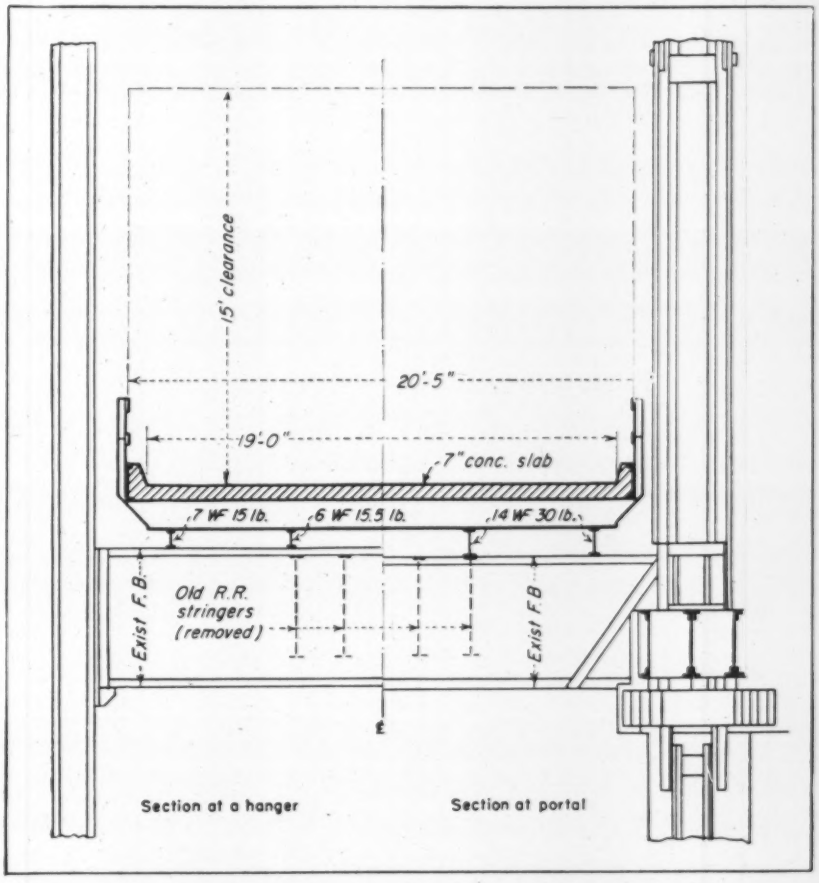
Crossing the Colorado River at Topock, Ariz., the single track Red Rock Bridge was given to the states of Arizona and California by its original owner, the Santa Fe Railroad, when a new railroad bridge was completed nearby early in 1945 (*ENR* June 21, 1945, vol. p. 862).

Completed in 1890, the Red Rock Bridge was the center of great engineering interest at the time as it was claimed to be the longest cantilever bridge in the country. Originally consisting of a 990-ft. cantilever through truss including a 330-ft. suspended simple truss span and a 120-ft. deck girder approach span, this bridge was strengthened from time to time to provide for increased locomotive loads. In 1901 the floor system was replaced with heavier construction, and in 1910 a concrete pier was built under the center of the 330-ft. suspended span and changes were made in the trusses. Considerable work has been necessary since 1931 to keep the bridge suitable for railway use.

The existing highway bridge, which is just downstream, is below present standards in that it has a width of only 17 ft. and is limited to light loads. The converted railroad bridge will correct these deficiencies at a reasonable cost to the two states. In addition to the bridge, some two or three miles of the old railroad bed will be used to provide better grades and alignment than on the present highway. A slight shortening of the route will also result.

The main items involved in the conversion from railroad to highway use are the installation of sub-floorbeams and the laying of a concrete deck. Superimposed on existing floorbeams and stringers, the new sub-floorbeams are 14-in., wide-flange, 30-lb. steel sections placed at 5½ and 6-ft. centers. It was necessary to use such a built-up sub-flooring system in order to make the roadway as wide as possible instead of placing the concrete slab on the same stringers used for support of the railway. Main floorbeam connections to the trusses at several panel points extend a considerable distance out from the trusses and up from the floorbeams and would have made it necessary to adopt a narrower roadway unless the level were raised.

With a 19-ft. width (two lanes) between 9-in. curbs, the new bridge floor is a reinforced concrete slab 7 in. thick at the center and 6 in. at the curbs. Main reinforcing is longitudinal. A 15-in. channel in the out-



Sections of the Red Rock Bridge at Topock, Ariz., indicating how redecking will convert the railroad structure for highway service.

side face of the curb acts as an edge beam to stiffen the slab, and was also used as a concrete form. This channel is held in place by a tie rod, which is fastened at one end to the highway floorbeam. The new deck was designed for H-15-S12 loads (a standard 15-ton truck with 12-ton trailer).

The job also includes the installation of steel protective railings and the removal of some 2¾-in. square bars added as structural reinforcing to tie top and bottom chords together at a few panel points for the heavier locomotive loadings. This reinforcing is being removed because it is not required for the highway loadings and because it would infringe on the lateral clearance.

Plans and specifications were prepared by the bridge division of the Arizona Highway Department, and were checked by the bridge department of the California Division of Highways. Construction is being supervised by Arizona officials. R. A. Hoffman is engineer of bridges and dams for Arizona and F. W. Panhorst is bridge engineer for California. The work is being done under contract by H. L. Royden, of Phoenix, Ariz., and will cost about $60,000, which the two states will share on a 50-50 basis.

Time Lost at Railroad Grade Crossings

The fact that highway fatalities at railroad grade crossings are on the increase and that the latest federal-aid highway act made liberal provision for crossing eliminations has again focused attention on the selection of crossings to be eliminated. How such studies can be expedited was the subject of a report given before the recent 43rd annual meeting of the American Road Builders Association, in Chicago, by Robert B. Brooks, consulting engineer, St. Louis, Mo., and chairman of the association's Committee on Railroad-Highway Grade Separation.

According to statistics of the National Safety Council, said Mr. Brooks, six percent more people were killed or injured at railroad-highway grade crossings in 1945 than during the preceding year. Approximately 1,960 were killed and 4,470 injured. But while the hazard factor looms large to the average motorist, it is small in comparison to the economic issues of the delay factor. Preference should be given, however, to the elimination of grade crossings having a bad accident record when the difference in the time delay factor is small. These accident records can be established with reasonable accuracy from the number of accidents at various railroad grade crossings as reported by the state highway departments, the National Safety Council and the Interstate Commerce Commission, Mr. Brooks said.

But determining the time-delay factor is more complex, said Mr. Brooks. And as an aid to its solution he included in his report the accompanying formulas which were prepared by F. W. Panhorst, bridge engineer, and R. T. Israel, assistant bridge engineer, Department of Public Works, California, in conference with Wm. J. Hedley, assistant chief engineer, Wabash Railroad Co., St. Louis. With the aid of these formulas the total delay at railroad grade crossings can be calculated in vehicle minutes per 24 hours. They are based on two factors: (1) delay due to passing of trains and (2) delay due to safety stops—required by law in California for all buses and all trucks carrying gasoline or explosives.

Data needed for applying the formulas can be obtained without too much trouble, said Mr. Brooks. For each crossing under study the average number, length and speed of passenger and freight trains, together with the number of switching movements and time occupied can be obtained from the railroad company. Highway vehicle traffic separated into trucks and buses can be obtained from the state records.

The following variables are used in applying the time-delay formulas at grade crossings:

M_t = Time in minutes that train occupies crossing:

W = Time in minutes of advance wigwag operations (assumed 0.50 for steam and 0.33 for electric trains).

A = Time in minutes required for vehicle to regain normal speed after train passes (assumed 0.33).

T = Number of trains per day.

V = Number of vehicles per day.

P_t = Percentage of trucks to total traffic.

P_b = Percentage of buses to total traffic.

The first factor, that of delay due to the passing of trains, equals the number of vehicles stopped per day multiplied by the average lost time per vehicle. Moreover, in any 24-hour period the number of vehicles stopped is equal to the number of minutes during which time the crossing is blocked multiplied by the total number of vehicles and divided by the number of minutes in a day, or:

Number of vehicles stopped =

$$\frac{\left(M_t + W + \frac{A}{2}\right) T}{60 \times 24} \times V \qquad (1)$$

Furthermore, the average time lost per vehicle stopped equals one-half the total time consumed by the passing of one train including time lost due to vehicle acceleration, or:

Average time lost per vehicle stopped =

$$\frac{M_t + W + \frac{A}{2}}{2} \qquad (2)$$

Multiplying formula (1) by formula (2), we get:

Delay due to trains passing =

$$\frac{\left(M_t + W + \frac{A}{2}\right) TV}{1{,}440} \times \frac{M_t + W + \frac{A}{2}}{2} = \frac{M^2 TV}{2{,}880} \qquad (3)$$

where $M = \left(M_t + W + \frac{A}{2}\right)$

The second factor (delay due to safety stops), is equal to the number of buses, plus the number of trucks carrying gasoline or explosives multiplied by 0.50 minutes, or:

Delay due to safety stops =

$$0.05\ V\ (P_b + 0.081\ P_t) \qquad (4)$$

By combining formulas (3) and (4), we get:

Total delay =

$$\frac{M^2 TV}{2{,}880} + 0.50\ V(P_b + 0.081\ P_t) \qquad (5)$$

The multiplier 0.081 in the above formula was obtained from the recorded data of the California state-wide truck survey, which showed 8.1 percent of the total trucks in the state were subjected to safety stops. Other constants used in the formulas were obtained from experimental studies conducted in the field, according to the report by Mr. Brooks.

National River Basin Policy Needed To Give All Regions Equal Opportunity

W. C. McNown

Professor of Civil Engineering
University of Kansas, Lawrence, Kan.

***Contents in Brief**—Despite failure of "valley authority" bills to make headway in Congress, river basin development remains a live subject. The author, not only from long-time studies of river resource conservation but out of experience as engineer for a number of local flood control districts, suggests Congress adopt a policy of fostering nationwide river development instead of periodic concentration on a few major streams such as the Missouri or the Columbia.*

THERE IS NEED for the adoption by the Congress of the United States of a national policy for river basin resource development, covering such activities as flood control, improvement of rivers for navigation, the development of hydro-electric power, the storage of water for irrigation and the development and conservation of such other resources as soil, forests and minerals.

In the Colorado River basin extensive work has been done under a compact between the states; in the Tennessee Valley work has progressed far under a federal corporation known as the Tennessee Valley Authority; and Congress has had before it the Murray bill intended to create a federal corporation patterned after the TVA for the Missouri River basin, while another of somewhat different type is proposed for the Columbia River basin. But, it is becoming increasingly clear that the time has come to discontinue such piecemeal development of our river basin resources, and for Congress, in one act, to define regional boundaries and otherwise to provide for the simultaneous development of all regions, perhaps following a pattern similar to that used in building our national system of highways.

As matters stand at present, extensive work may be done in some river basins, and little or none in others. For example, during the period from 1935 to 1939, TVA received more than 12 percent of all funds expended for resource development, yet the Tennessee Valley contains only 5 percent of the country's population. With that fact in mind, and noting the current requests of those representing the Missouri and Columbia river basins, it is proper to question whether it is sound national policy to develop the country's river basin resources one by one, or whether the work should proceed simultaneously in all.

The problem would seem to be one of organization. The Tennessee Valley experiment may be counted as a success, but it does not follow that its pattern is one to adopt elsewhere. Moreover, if the federal corporation type of organization were to be extended, over, say, the nine regions listed in the Rankin bill (HR 1824), then the Department of Interior, including as it does the Bureau of Reclamation and the Bureau of Mines, would be to a large extent liquidated, since those functions would be absorbed by the regional authorities, as would also the peacetime river improvement work of the U. S. Engineer Corps. Forestry and soil erosion control would pass from the Department of Agriculture. It may be concluded that Congress will not, and probably should not, proceed farther in that direction.

Missouri Valley plan inadequate

Nor does the Pick-Sloan plan authorized by Congress in 1944 to cover flood control, navigation, irrigation and hydro-electric power development in the Missouri Valley serve the entire need, since it is particularly lacking in aids to agriculture, such as demonstration projects that would advance farming methods and improve soil erosion protection practices.

What seems to be needed is a national resource administration to coordinate regional activities under resident regional organizations. This, coupled with the establishment of uniform national policy of river resource development throughout the entire country, would be likely to produce the results that are so widely accepted as necessary.

Viewing the problem as being primarily national rather than regional, a program of Congressional action, in substance as follows, should be worth consideration:

1 Divide the country into regions suited to river resources development, and define their boundaries.

2 Establish a national regional river resource administration headed by the secretaries of Agriculture, Interior, and War and the chairman of the Federal Power Commission.

3 Provide for a deputy administrator, who would, in effect, become the national administrative manager, and whose term of office could continue over changing political administrations.

4 Provide for regional administrations through commissions set up to include a representative from each state or major fraction of a state in a region, appointed by the governors.

5 Provide that each regional administration should appoint from the country at large a regional manager, representing the best specialized talent available.

6 Appropriate funds each year in an amount suited to the needs of the regions, and to the national budget, such funds to be apportioned to the several regions by formula. One based on area, population, and mileage of principal rivers might serve the purpose.

7 Provide for nonpartisan performance in all matters pertaining to the work.

8 Assign all local research, planning, construction, operation, and maintenance to the regional administrations and require that all plans be approved by the national administration.

9 Provide that the national administrator should make such regulations as necessary to carry out the purposes of the act.

10 Provide that failure on the part of any regional administration to act in conformity with the provisions of the law might result in the loss of funds for a period.

11 Provide for the ultimate development of all incidental hydro-electric power, and make provision for its use in the resource development of the several regions and the country at large at rates that would return to the government its investment in power installation, and eventually pay for the cost of the administration, operation and maintenance of regional resource activities.

12 Provide all necessary powers to the national and regional administrations to carry out the purposes of the act. The powers now granted to the federal corporation set up in the Tennessee Valley and in the several bills now before Congress seeking to create other authorities should be divided appropriately between the national and regional administrations.

Congress should find relief in the early adoption of some such overall plan. The people in the smaller river basins, whose need is proportionally as great, should welcome the opportunity to get started on their river resource work along with those in the larger and more influential ones. It is due perhaps to a train of events leading from the early policy of river improvement to the Colorado River basin states compact and the Tennessee Valley Authority that the country has drifted away from the obviously logical and effective plan for river basin resource development.

Plans for Transforming San Francisco Bay Studied by War and Navy Departments

A RESOLUTION recently passed by the House of Representatives requesting the Army and Navy to consider the "Reber plan" focuses attention on this comprehensive project for the transforming of San Francisco Bay. The resolution (see *ENR* Apr. 11, 1946, vol. p. 525) specifically requested the consideration of the feasibility of a second Bay Bridge or "a system of dams across San Francisco Bay as provided in the so-called Reber plan."

Hearings called for by this Congressional resolution are to begin in San Francisco on Aug. 12 before a joint board of engineers from the Army and Navy set up for that purpose.

Details of the Reber Plan

Named for John Reber, who first suggested it many years ago, and estimated to cost some $200,000,000, this project is based upon the construction of rock- and earthfill dams across north and south arms of the bay. Prominent features are (a) a 50-mile increase in the deep-water harbor line, (b) formation of two fresh-water lakes with a total area of 280,000 acres, (c) creation of enormous areas for industrial uses, such as airports, manufacturing and military purposes and, finally, (d) closer connection of the entire metropolitan area by providing for transbay transportation by rail and highway on solid earthfills.

One of the dams would be built from San Francisco to west Oakland on the south side of the present Bay Bridge; the other, in the north arm of the bay, would extend from the Marin County shore to the Contra Costa County side. The two fresh water basins thus formed would be connected by a ship channel dredged along the east bay shoreline. The two lakes would be kept at about high-tide level and water traffic to and from the salt water portion of the bay would be through ship locks in the fill opposite the Golden Gate. The project calls for about 750,000,000 cu.yd. of hydraulic fill. Most of this would be dredged from the ship channel, to be 50 ft. deep, and from the salt-water harbor. Some 19,200,000 cu.yd. of rock would be required for toe walls for the two dams.

The north dam, in water whose maximum depth is 51 ft., would be 4 mi. long and 600 ft. wide and would serve as a spillway for flood waters from the Central Valley. At the south dam the water depth is 72 ft. This dam would be 2,000 ft. wide and 4 mi. long. At the east end of tthe south dam traffic tunnels would lead under the half-mile ship channel.

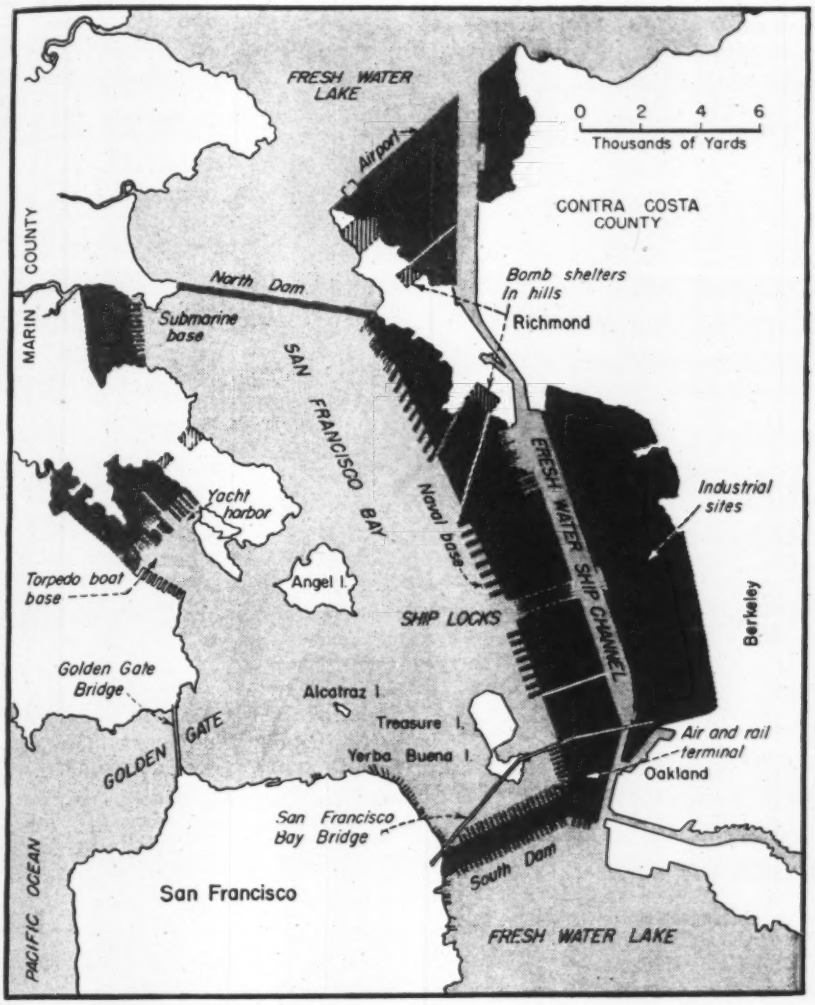
Advantages claimed for plan

Objectives that justify the cost of these dams, proponents claim, are the industrial and military advantages of a transbay fill 2,000 ft. wide on which main line railroads could be brought directly into San Francisco and on which there would be ample area for the railroad freight yards for which no space is now available within economic limits even if the overland railroads were brought in to San Francisco. On the east end of this south dam would be a site for a great central air-water-rail terminal. A group of six-lane highways could cross the south dam and fan out at the shores, swinging to the left or right of congested areas, providing freeways that would skirt business districts on high speed routes to (1) Marin County, (2) Richmond, Vallejo and the Sacramento Valley, (3) the San Francisco peninsula and San Jose and (4) Alameda and San Joaquin Valley points.

Plan favored and opposed

L. H. Nishkian, San Francisco consulting engineer, says, "I have studied this plan for over five years and have seen no serious engineering objections or insurmountable difficulties. The advantages can be shown to exceed in value $3 to $4 billion, which can be had for an expenditure I estimate, with present-day costs, at about $200,000,000. This figure includes, in addition to all fills, six ship locks, ten tubes under the ship channel at the east end of the south dam and all other elements necessary to put the plan into operation. A new transbay bridge would cost more than $100,000,000. No such expenditure for a bridge can be justified in view of the much more extensive facilities offered in the Reber plan."

However, the feasibility of this plan has been challenged by other promi-



Central portion of San Francisco Bay. Deeply shaded areas show proposed location of the two transbay dams and shallow areas to be filled in for industrial uses.

nent engineers. The consensus of the opposition is that before the plan can be safely accepted as sound it must have had thorough study of the sort that is based on surveys and tests requiring some considerable expenditure of funds.

Foremost among the objections to the plan is the claim that reducing the tidal prism (volume between mean low tide and mean high tide), will decrease the maximum velocity through Golden Gate and that this would result in accumulations of sand in the entrance channel. It is claimed that the continuous off-shore dredging that would then be required to keep a channel cleared would become too hazardous and too expensive. An alternate means of maintaining channel depth, the building of a jetty, is also said to be too costly.

A second controversial part of the plan is the proposal that the fresh water lakes formed by the two dams serve as reservoirs from which water could be drawn for irrigation and industrial uses.

Salinity issues raised

Proponents of the project claim that, with evaporation figured at 3½ ft. per annum, more than half of the 2,400,000 acre-ft. per year from Shasta reservoir alloted to salinity control would be saved. On the other hand, opponents state that due to evaporation and the operation of locks and fish ladders the lakes would waste more water than they would save. Further objection to this part of the plan is based on the claim that the lakes would not stay fresh and usable. Some engineers are dubious about the success of salt water barriers; others claim that sewage and industrial wastes would make the water unredeemable for other uses.

Because of the many objections to certain features of the project, there are those who are supporting the construction of only one of the main features which they believe offers special advantage, namely, the south dam. This dam, which they propose to substitute for a second Bay Bridge, would be built from the San Francisco side of the bay, leaving a 2,000-ft. channel near the Oakland shore to be crossed by tunnels. The cost for this portion of the Reber plan is estimated to be about $100,000,000, which is said to compare favorably with the probable cost of a second bridge.

Consideration of the Reber plan by the Navy and War departments under the resolution mentioned in the foregoing will be the first time it has been studied by any official bodies and the first official consideration of a bay crossing not by bridge. Lieut.-Gen. Raymond A. Wheeler, Chief of Engineers, said in a recent interview that the Corps of Engineers is practical enough to want to study all possible solutions to a problem of this sort.

Is 3,457 Sq. Mi. of Lake Erie Part of Ohio's Road Area?

Because federal aid to states for building major highways and secondary roads is based one-third on the area of the state under the federal-aid highway acts, an interesting difference of opinion has arisen between Perry T. Ford, highway director of Ohio, and Commissioner Thomas H. McDonald of the Public Roads Administration as to the amount of federal aid to which Ohio is entitled.

The question is whether or not 3,457 sq. mi. of Lake Erie should be included in the area of the state. Director Ford says Ohio ends at the international boundary out in the lake; Commissioner MacDonald says it ends at the shoreline. The financial difference involved is $94,863 a year, and Mr. Ford thinks that is worth fighting for although Ohio's share for the next fiscal year is scheduled at $20,101,990.

In justification of Ohio's contention, Representative Homer Ramey says that Utah is allowed to claim Great Salt Lake as acreage, and points out that Michigan is claiming 38,575 sq. mi. of external water as part of its area.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

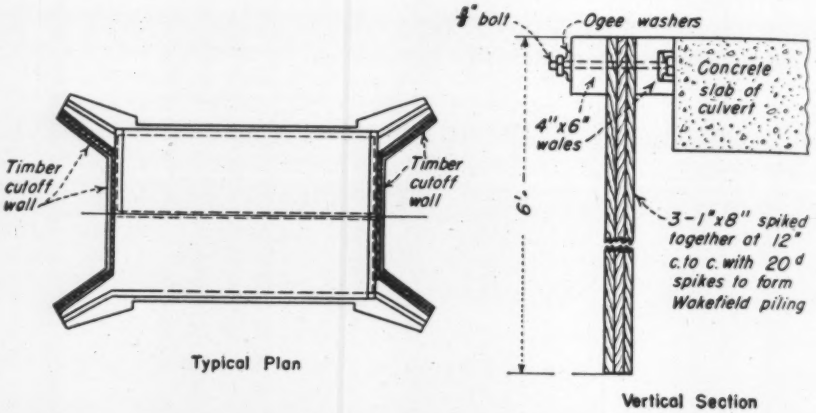
Cutoff Walls and Riprap Reduce Culvert Maintenance

Wherever feasible, large concrete culverts are constructed by the South Carolina State Highway Department instead of small bridges. This practice is frequently followed although it adds to the first cost because of the advantages of unrestricted roadway width and lower maintenance charges. At many of these large culverts built in the past the foundation material was of a type easily eroded, and experience has shown that the concrete cutoff walls generally were carried to an inadequate depth.

For this reason, the department now requires that for large culverts in such locations plain timber Wakefield cutoff walls be driven at both the upstream and downstream edges of the bottom slab and wingwalls. This type of construction prevents the undermining of the large culverts while carrying floodwaters.

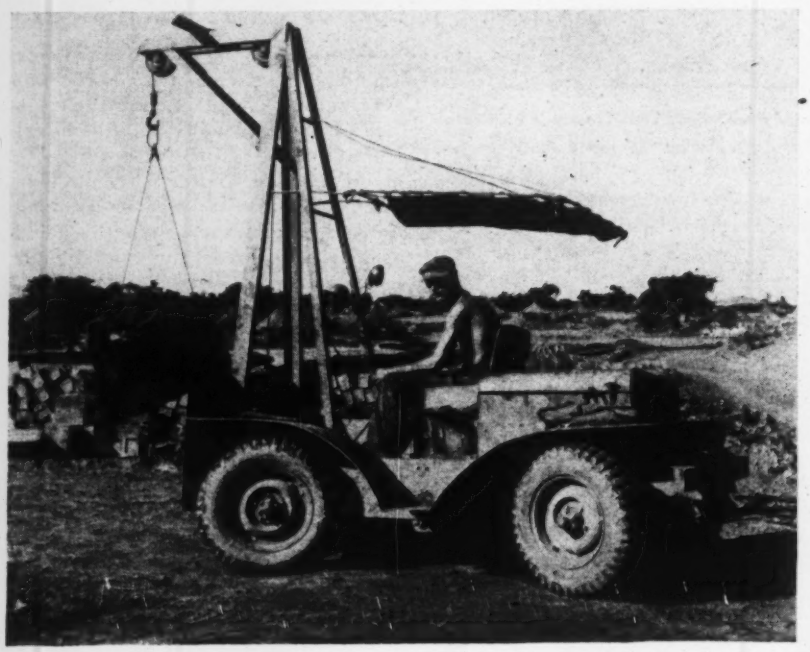
The sheeting is driven before construction of the bottom slab. Three thicknesses of 1-in. thick untreated timber are used. A minimum length of 6 ft. is preferred. If the foundation conditions are such that a penetration of 3 ft. below the top of the slabs cannot be secured, concrete cutoff walls are constructed. The sheet piling is secured at the top with two 4 x 6-in. wales, which permits settlement of the culvert without causing the cutoff walls to come into bearing.

Engineers of the department also specify that a heavy layer of riprap be added behind the wing walls of the large culverts, both upstream and downstream. This stone prevents severe erosion of the earth embankments by eddy currents during floods. The riprap is generally extended beyond the wing walls at each side for a minimum distance of 15 ft.—W. J. Gooding, Jr., *Bridge Engineer, South Carolina State Highway Department, Columbia, S. C.*



Maintenance difficulties with large culverts constructed on erosive material may be reduced by construction of Wakefield cutoff walls at each end, experience of the South Carolina State Highway Department shows.

CAMERA MEMORANDUM



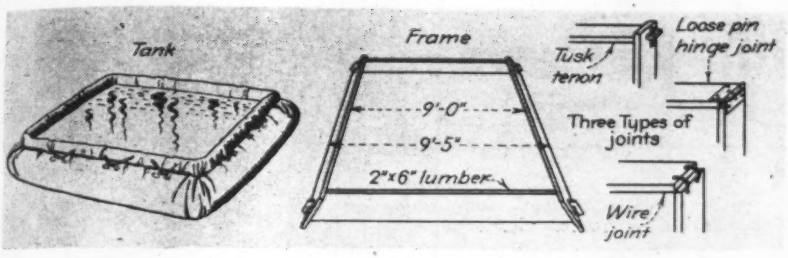
U. S. Signal Corps Photo

A possible use for the jeeps now on the market is indicated by this picture of a "jeep lift" built by one of the U. S. Engineer battalions for picking up light loads.

Self-Supporting Water Vat

The water storage vat illustrated in the accompanying drawing has a capacity of 900 gal., is self-supporting and can be easily built in the field at nominal cost.

Construction consists of a wood frame 9 ft. square of 2x6-in. lumber with edges splayed at an angle of 60



Sloped plank frame is self-supporting feature of tarpaulin water tank. Three simple types of cover joints for fastening the framework are shown at the right.

deg. Any one of the three types of joints shown in the illustration can be effectively used. A tarpaulin 16 ft. square is laid out and the frame placed centrally over it. Folded inward through the frame and over the sides, the edges of the tarp are lashed by ropes to loops sewed on the canvas so that no part of the edges is below the frame.

The converging sides of the vat rise automatically as the tank is filled with water.

Care must be exercised in the continued use of the tank if its bottom rests on the ground or on an airtight surface as sweating and mildew will soon destroy it.—Courtesy of *The Maintenance Engineer*, published by the Office of the Chief of Engineers.

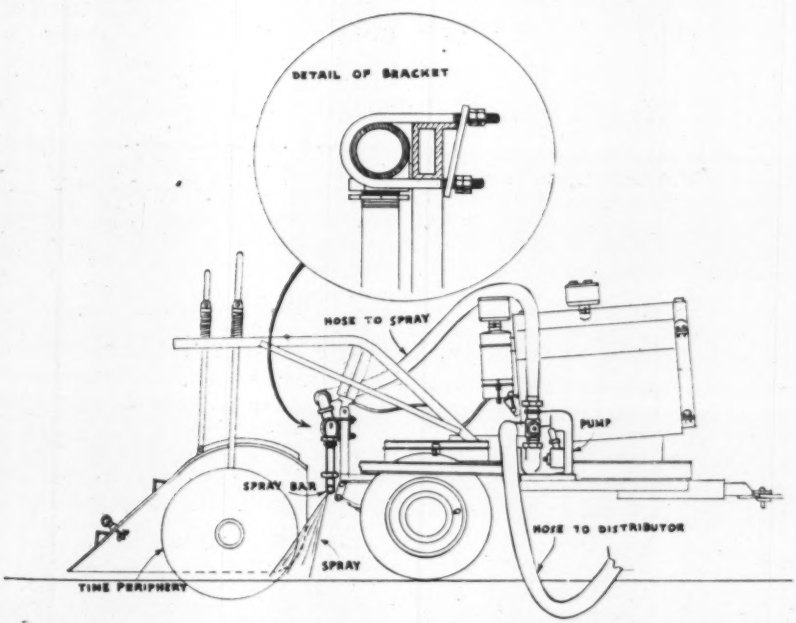
Spray-Bar Attachment Improves Mixing Work

Mixing operations in using rotary mixers can be greatly improved at little cost by addition of the auxiliary pump and spray-bar attachment illustrated by the accompanying drawing. Although very simple, the device will result in much greater efficiency.

The development was built to fill a marked need for three improvements. These are: (1) Closer control of the water increment in road mixing for the several soil stabilization processes, thereby preventing water migration and reducing evaporation loss; (2) better control of the bitumen to obtain better coverage, eliminate migration and obviate "rich" and "lean" spots on bituminous work; and (3) improved control of the water increment in earth fills by increasing the efficiency of water as a soil-particle lubricant, by obtaining a quicker, more intimate mix and preventing migration and evaporation loss.

The spray bar is made as wide as the mixing rotor and is attached by means of suitable brackets to the mixer at the rear cross member of the frame supporting the hydraulic ram. The spray should be so directed that it intersects the spillover of the material at the front of the hood about 3 or 4 in. above the ground. The balance of the spray should meet the ground just ahead of the spill-over. This design allows water or oil to be mixed almost immediately with the material.

The equipment may be built and installed readily in the shops of state highway departments and contractors. However, at least one manufacturer, Seaman Motors of Milwaukee, which supplied the illustration, will supply the spray bar, brackets and pumping unit at a moderate cost.



Mixing operations in using rotary mixers may be improved at little cost by installation of a spray bar attachment of the type illustrated.

Modified Septic Tank Rules Cut Miami Sewage Costs

Regulations for installation of septic tanks in Miami, Fla., are being modified in an effort to cut construction costs for persons building homes during the next two years. In general, however, the modifications apply only to those areas of the city that will be served by the proposed sewage system, for which bonds were overwhelmingly voted in a recent election.

At present, the required size of septic tanks in the city varies, minimum size being 500 gal. for a two-bedroom house. An added 100-gal. capacity is required for each additional bedroom after the first two. This schedule also holds for apartments and hotels.

Minimum amount of drainfield required is 75 ft., with an added 25 ft. for each additional bedroom. Besides this, drain tile must also be laid over 4 in. of ¾-in. washed rock.

Among modification proposals approved by the Florida State Board of Health, according to Herbert Schaller, chief plumbing inspector, are a one-third reduction in required length of overflow drains and elimination of the requirement that drain tile be laid in ditches lined with washed rock.

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

A Functional Approach

AIRPORT PLANNING—By Charles Froesch and Walther Prokosch. 250 pp. John Wiley & Sons, New York; Chapman & Hall, London. $7.

Planning for new airports or for the modernization of old ones is approached from the functional angle in this book. Specific design details, the authors state, can be found in other textbooks, published articles and papers, to which there are numerous references at the end of each chapter. However, much basic information essential to good design is given.

The great value of this book lies in the fact that it is written by two men of wide practical experience, the chief engineer and the architect of Eastern Air Lines. They know the type of information that is needed by anyone planning an airport to meet specific conditions and they present that information in concise and understandable form.

Careers in Engineering

BUILDING AN ENGINEERING CAREER—Second Edition. By Clement C. Williams. 309 pp. McGraw-Hill Book Co., New York 18. $2.50.

In revising this book that now is widely used in vocational guidance work and as a text in engineering schools the author has expanded his discussion of the principal fields of engineering and has amplified what was said in the first edition about the social aspects of an engineering career. As an aid to engineering teachers, Mr. Williams has included a listing of films that can be borrowed to use in discussions of the various types of engineering work.

Concrete Design Text

DESIGN OF REINFORCED CONCRETE STRUCTURES—Second Edition. By Dean Peabody, Jr. 532 pp. John Wiley & Sons, New York 16, N. Y. Chapman & Hall, Ltd., London. $5.50.

Expanded 15 percent over the first edition, the new volume contains added material on shrinkage, plastic flow, torsion, continuous frames, plastic theory of design, prestressed concrete, beams curved in the horizontal plane and design of forms. Almost every subject is covered thoroughly, and derivations and methods are explained in an unusually lucid manner. Conforming in general with the 1941 *Building Regulations for Reinforced Concrete* of the American Concrete Institute or with the 1940 Joint Committee *Recommended Practice for Concrete and Reinforced Concrete*, the text is sufficiently up to date and arranged as to be a handy reference for designers.

Better English

THE ART OF PLAIN TALK—By Rudolf Flesch. 210 pp. Harper & Brothers, New York and London. $2.50.

There is a lot of good sense and perhaps a bit of nonsense in "The Art of Plain Talk". People whose business or desire is to convey ideas with the written word—and that includes almost everybody—will obtain valuable hints on effective presentation. Just to browse through the book will be an adventure in reading some excellent writing.

To this reviewer, the most important point made by Dr. Flesch is to write as you talk; be casual, intimate and simple in your expressions. And don't be rigidly bound by rules of grammar. If a split infinitive or a dangling preposition straightens or shortens a sentence, use it.

There are three things, says Dr. Flesch, that make for simple language: short sentences, few affixes and many personal references. You can measure them and compute a "difficulty" score for whatever you are reading or writing. Here is the formula:

"First, take the average length of the sentences and multiply it by .1338. Then, take the number of affixes per 100 words and multiply it by .0645. Add these two figures. Next, multiply the number of personal references in 100 words by .0659 and subtract the result from the sum of the first two figures. Finally, subtract .75. The result is your difficulty score, which is apt to be a figure between 0 and 7."

We did not compute the score for this review, but maybe if we had we would not say that use and application of the formula is a bit of nonsense in a book that has a lot more to recommend it.

In brief, this book will give you courage to write like you talk, and the rules of grammar be damned!

Miscellaneous Notes on Booklets and Reprints

NEW WEIGHT AND DIMENSION STANDARDS for highway vehicles, adopted by the American Association of State Highway Officials on April 1, 1946, are contained in a pamphlet of the association entitled "Policy Concerning Maximum Dimensions, Weights and Speeds of Motor Vehicles to be Operated Over the Highways of the United States." Copies can be obtained from the association's offices, 1220 National Press Building, Washington 4, D. C.

THE NATIONAL HIGHWAY USERS CONFERENCE has issued 1946 editions of the following large pamphlets: State Restrictions on Motor Vehicle Sizes and Weights ($2); Registration Fees and Special Taxes for Motor Vehicles ($2); and Equipment Requirements for Motor Vehicles ($2). Copies can be obtained from the National Highway Users Conference, National Press Building, Washington 4, D. C.

New Engineering Books

THE ART OF PLAIN TALK—By Rudolf Flesch. 210 pp. Harper & Brothers, New York 16, $2.50.

AIRPORT PLANNING—By Charles Froesch and Walther Prokosch. 250 pp. John Wiley & Sons, New York; Chapman & Hall, London. $7.

DATA BOOK FOR ENGINEERS: Volume II—Specifications and Costs—By Elwyn E. Seelye. John Wiley & Sons, Inc., New York; Chapman & Hall, London. $6.75.

INTERSTATE COMPACTS—Four Volumes—Prepared by the Colorado Water Conservation Board, 212 State Office Bldg., Denver 2, Col. Limited Edition.

PORTLAND CEMENT CONCRETE PAVEMENTS—Section F of Standard Specifications for Public Works Construction. 30 pp. American Public Works Association, 1313 East 60th St., Chicago 37, Ill. $1.50.

(*Continued on p.* 133)

OPA IS DYING—
. . . *what next?*

IT IS NOW clear that direct price control of the OPA type is on the way out, if not by legislative limitation then by administrative collapse.

It is equally clear that we are by no means past the danger of a swirling upsurge of prices.

Then does it follow that the passing of OPA need be tantamount to a decision to let 'em rip?

It does not.

While the OPA machinery is grinding to a stop, we can bring into play more fundamental measures to keep prices within safe limits—and to allow private management a wider area of freedom. What this article proposes is a framework of control within which private business judgment can operate. Therefore, this preamble speaks directly to our friends in the business community.

Now is a time for unrelenting self-restraint by business management. As price control disintegrates, business must scrupulously hold to prices which, after covering costs, yield *normal* profit margins. Business has everything to lose and nothing to gain if its price policies emulate the excessive wage demands made by some unions.

True leaders of business sense the danger. They do not want to price themselves out of their markets. They do not want the tag of price hogs. They do not want a buyers' strike. All management must practice the self-restraint which characterizes the wisest leaders among us.

What Wasn't Done

Virtually all responsible economic analysts agree that if direct price control is eliminated and nothing else is done, prices will move upward. The only serious disagreements are: How far? And for how long?

Some careful and competent forecasters believe that, if all price control is lifted, the official cost of living index will shoot up at least 25 per cent within a year. Some of them think that wage rates will chase right after prices, forcing new price increases until the whole operation ends in a dizzy crash.

Others agree that prices will go up all right, but they think that increased production, made possible by disentanglement from OPA red tape, will bring them down again fairly soon.

Recent developments seem to support those forecasters who think that wage increases would chase right after price increases and thus keep "the inflationary spiral" spinning toward a ghastly fall. Unions already agitate for a new round of wage increases to offset price increases which have occurred in the few months since the last round of wage increases.

Therefore, the prudent course would have been to clean up the OPA price control system, to keep it in place for a limited period as a stop-gap, and, meanwhile, to arrange to replace it with more fundamental controls, PROVIDED the federal government itself stopped promoting excessive wage increases. *The greatest single contribution to the wrecking of the OPA has been the holes driven in price ceilings by government-promoted wage increases.*

But now the stop-gap is being eliminated, and the fundamental controls are not in place. Their erection becomes urgent.

The Basic Task Now

The danger that prices and wages will get to chasing each other around a ruinous spiral arises, of course, from the accumulation during the war of an enormous sum of money that could not be spent because about 40 per cent of the nation's production was being devoted to war. Men were paid wages and profits for making artillery shells. The shells were exploded. The money remains. It has piled up until the people's backlog of cash spending power, in one form or another, exceeds $225 billions—three times the total in 1939.

More than that, banks hold $115 billions of government securities—a sixfold increase since 1939. These securities can serve as the basis for an expansion of bank credit of many times their volume. A dollar of bank credit will, of course, buy as much as a dollar of cash.

The first and basic task of preventing runaway prices is: *Get this huge accumulation of purchasing power, actual and potential, under some kind of effective control.*

A second task is to see that no unnecessary additions are made to the flood of purchasing power overhanging the market. A third task is to get the productive machinery of the country running at top speed so that it can take up the accumulation in an orderly way, not in a boom-bust sequence. We shall talk here only about the first two of these tasks.

Are there ways of getting at the root cause of a disastrous wage-price spiral which are being neglected? There are many of them. Attention has been distracted from them by building up the battle over OPA as the Armageddon of price stabilization. It is important. But it is not Armageddon. If everything that Mr. Bowles and his associates want done by way of price control legislation were done, the problem of price stabilization would still remain unsolved in the continued absence of a program to deal effectively with root causes.

Basic Remedies

Here is a rough outline of the key elements of a basic program.

1. Cut public expenditures to the bone and let tax revenues accumulate as business volume increases—perhaps broadening the tax base at the same time.

Now, if ever, is the time to run a surplus and to use it to retire debt. Immediate upward pressure on prices would thus be removed and the burden of carrying debt when the going gets tougher later on would be relieved. A $10 billion surplus of federal, state and local revenues during the next year might not be too much.

An increase in social security taxes, as the House Ways and Means Committee proposes, offers one of a number of good ways to increase revenues. Deferring public works not immediately needed affords one of numerous ways by which substantial cuts in expenditures can be made.

2. Tighten the terms on which installment credit is available for the purchase of houses, automobiles, and other consumers' goods.

Allowed to run a free course, expansion of credit to buy houses and durable consumers' goods might easily add $15 billion to consumer purchasing power next year. No such injection of credit is needed now. The more a man buys "on time" the more cash he keeps to spend on something else. For most products the cash market alone is more than big enough to keep producers busy and customers healthy.

3. Restore to the Federal Reserve system its lost control over the supply of credit by limiting the opportunities for credit expansion now afforded by huge bank holdings of government securities.

The specific measures needed are highly technical, but are agreed upon by banking experts as both feasible and fair. The important thing for the public at large to do is to recognize that we are, in effect, sitting on a powder keg with lighted match in hand until the measures are taken.

4. Revive a vigorous campaign to sell government savings bonds and other government securities to the public.

Sale of government savings bonds cuts down current consumer spending. It also allows the Treasury, if government spending is held down, to retire government bonds which the banks hold. Thus, it simplifies the problem of keeping bank credit within safe bounds.

5. Prevent a speculative inventory boom of the sort which preceded the post-World War I business collapse in 1920-21.

This involves a continuation of the loose controls of inventories now exercised by the government. In more important degree it involves well informed cooperation by bankers and business men to keep inventories from being expanded unnecessarily.

6. Maintain controls on exports in order to keep within reasonable limits the impact on our market of huge foreign demand.

Emergency foreign relief requirements must be met. But foreign demand which is enormous apart from relief requirements must be kept under control until the danger of having it send prices of export products soaring is past.

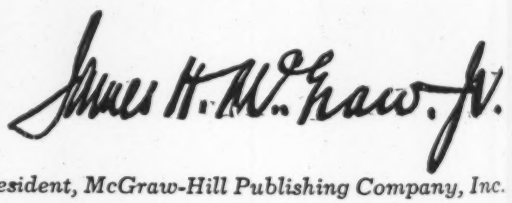
Breathing Space for Business

This program would deal with causes, not symptoms. Hence, if promptly and efficiently installed, it would do a far better job of keeping the general level of prices and wages within tolerable limits than the OPA type of price control ever could have done—even if OPA had not been so often and so badly mismanaged. The program would also do this without tying up American business in a myriad of irritating and discouraging individual regulations. It would establish broad bounds within which business enterprise would be free to be itself, not a branch of bureaucratic enterprise.

The program proposed here also has the major virtue of flexibility. If prices start to reverse their present upward course within another year, the major parts of the program can be adjusted or removed quickly.

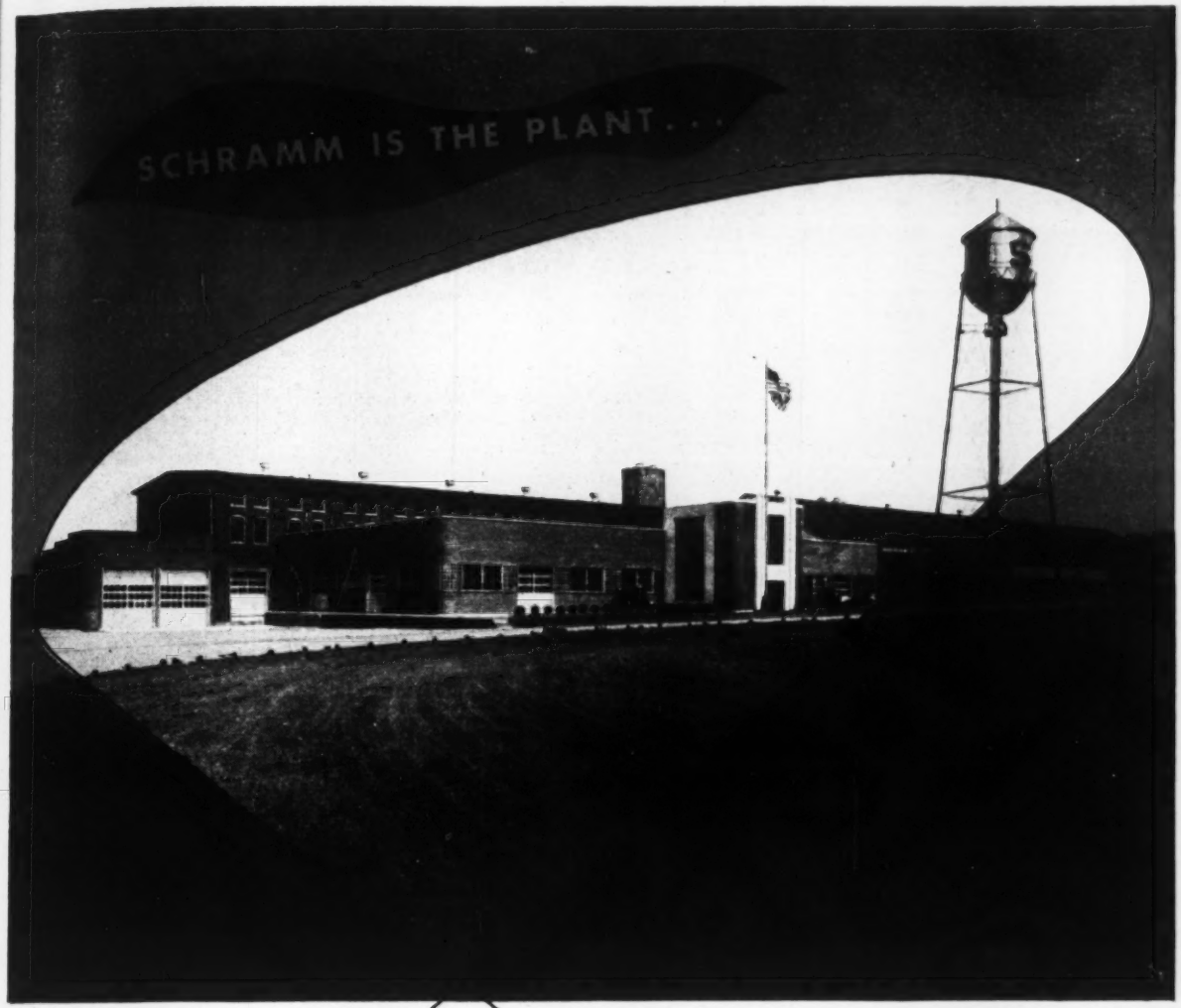
It would be gratifying to suggest junking at once all arrangements designed to place limits on price movements, even broad limits of the sort here suggested. But to do nothing while OPA falls apart, would be to run the grave risk of a runaway of prices and wages which, in the inevitable collapse, would do irretrievable damage to the business community and to the whole nation.

The risk is not worth taking.



President, McGraw-Hill Publishing Company, Inc.

THIS IS THE 49TH OF A SERIES



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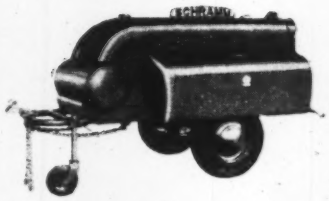

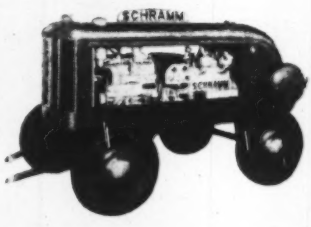

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MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

CAST IRON PIPE in July rose $3 per ton in all cities. Other increases effective country-wide were $1.75 per 100 lb. for RED LEAD and $1.25 per 100 lb. for WHITE LEAD. LIME, hydrated finishing, rose $1 per ton in Detroit, $1.20 in San Francisco, $.50 in Chicago, and $1.50 in Pittsburgh. Common hydrated lime rose $3 in Detroit, $1.20 in San Francisco, and $1.50 in Pittsburgh. Ready-mixed CONCRETE showed an increase of $.35 per cu. yd. in Boston.

In Pittsburgh, gravel, sand, crushed stone and crushed slag prices all increased, with a resultant rise of $.30 in the price of ready-mixed CONCRETE. ROOFING SUPPLIES prices went up in Chicago, Detroit, and San Francisco. LUMBER is still the most scarce item although prices are still rising. COMMON LABOR wages increased $.10 in Chicago, $.14 in Minneapolis, $.1875 in San Francisco, and $.065 in Seattle. The major increases in SKILLED LABOR were Bricklayers, $.125 in Los Angeles; Structural Ironworkers, $.125 in Boston; $.15 in Los Angeles; $.25 in San Francisco; and Carpenters, $.15 in Los Angeles.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F. O. B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL			CRUSHED STONE		CRUSHED SLAG		CONCRETE BLOCK		CONCRETE
	Per bbl., C/L lots incl. 40c. per bbl. for bags, cash dis. not deducted			Per ton, carload lots			Per ton, carload lots		Per ton, carload lots, f.o.b plant		8x8x16-in., truckload dei : per block		Ready Mixed 1:2:4, over
	Cloth a	Paper	Bulk	Gravel. 1½ in	Gravel. ¾ in	Sand	1½ in	¾ in.	1½ in.	¾ in	Sand-grav.	Lt.wgt Agg.	50 c.y., del.
Atlanta	$2.77	$2.52	$2.43	$1.79	$1.89	$1.65	$1.79	$1.89	$1.59	$1.69	$0.17	....	$9.00
Baltimore	2.62	2.37	2.12	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.75‡	1.75‡	.145	$0.145w	7.45
Birmingham	2.50	2.25	2.10	1.75	1.75	1.50	.85	1.00	.90	1.15	.1425	....	5.95
Boston	2.97b	2.72b	2.52	1.50‡	1.50‡	1.40‡	1.25	1.35	....	....	.13	.155w	7.90m
Chicago	2.90	2.65	2.50	2.15‡d	2.15‡d	2.15‡d	2.15‡d	2.15‡d	1.75‡	1.75‡	.18	.18x	....
Cincinnati	2.51	2.26	2.06	1.20	1.20	1.10	1.80	1.80	....	....	.13	.17w	6.85
Cleveland	2.59	2.34	2.19	1.75i	1.75i	1.25/1.65i	1.80i	1.80i	1.15	1.15	.14	.14	8.15
Dallas	2.51	2.26	2.06	1.80	1.80	1.45	1.72	1.82	....	....	.0875p	....	8.20
Denver	3.59	2.92	2.47	1.20	1.25	.90	1.65	1.75	1.00	1.00	....	.155	8.75
Detroit	2.59	2.34	2.16	1.75	1.75	1.55	2.25	2.25	2.00‡	2.00‡	.14	.15w	7.69
Kansas City	2.78	2.57	2.38	1.85	2.30	1.00	1.91	1.91	-- --	-- --	.16	.165wy	7.80n
Los Angeles	3.10v	2.50v	....	1.50	1.50	1.35	1.50f	1.50f	-- --	-- --	.125bb	.125bb	9.26m
Minneapolis	3.40dd‡	3.15dd‡	....	1.00h	1.00h	.25h	1.00h	1.00h	-- --	-- --	.155ff	....	7.60j
Montreal	....	1.95r	1.79r	1.65‡s	1.65‡s	1.50t	.80ct	.90ct	....	....	.1924	-- --	7.00q
New Orleans	2.41	2.16	1.92	1.67	1.65	1.21	....	....	.90	1.15	.23	....	9.25
New York	3.00‡	2.80‡	....	1.74deu	1.74deu	1.07ee	1.80ds	1.80ds	....	....	.16	.14wcc	8.25kq
Philadelphia	2.73‡	2.48‡	2.28‡	1.55‡	1.65‡	1.20‡	1.90‡	1.95‡	1.10	1.10	.155	.155w	8.55
Pittsburgh	2.80	2.55	2.35	1.85‡	1.85‡	2.15‡	2.35‡	2.35‡	1.80	1.80	.21	.21s	9.15
St. Louis	3.08o	2.80o	....	1.75‡o	1.75‡o	1.65/1.75‡o	1.25/1.95	1.25/1.95	.90g	1.15g	.155	.18yo	8.75
San Francisco	2.81	2.21	1.91	1.36	1.36	1.36	1.46	....	....	....	....	.225y	7.55
Seattle	....	2.75o	....	2.35d‡	2.35d‡	2.35d‡	2.85‡od	2.85‡od	....	....	.16	....	7.25

‡ Delivered. *a* 10c allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 per-cent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* 5 cu. yds. or more. *r* 10c per bbl. off cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* In outlying New York districts, price is $1.89. *v* 20c. per bbl. discount; 80c. per bbl. for bags. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 6 x 8 x 12 in. *cc* Also 8 x 18 in. *dd* Prices quoted are LCL. Carload lots not available. *ee* In outlying New York districts, price is $1.22. *ff* 8 x 8 x 18 in.

CASH DISCOUNTS CEMENT to Contractors: truck delivery 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c per bbl for payment within 15 days of date of invoice. Subject discount 10c per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c per bbl : 10c refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.90	$1.85	Ironton, Ohio	$1.80*	$1.75*	Universal, Pa	1.85	1.80
Hannibal, Mo	1.90	1.85	Northampton, Pa	1.75	1.70	Waco, Tex. (Plus 9c tax in Tex.)	1.75	1.70
Independence, Kans	1.90	1.85	Richard City, Tenn	$2.00	$1.95	Montreal City (Discount 10c per bbl 20 days)	1.68	1.67
			Steelton, Minn	2.00	1.95			

* Destination price base: effective Sept. 17, 1945

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OIL	ASPHALT EMULSION (Quick-breaking)	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in carload lots	Wood per sq. yd. 3½ in 16-lb treat	Per ton, less than 80 penetration		Per gal., 80-300 penetration		Per ton		Per gal	Per gal	
				Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	.....	$14.00	$0.074	.....	$0.0806h	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70	85.00m	15.00r	21.00r	.06r	0.09r	13.00r	23.00r	.06r	.07r	.14r
Birmingham	150.00	32.00j	.....	17.95	l	.0747	l	.0834h	l	.065	.095	l
Boston	85.00	59.00	3.75	16.00	25.00	.0675	.12	18.00	31.00	.0675	.0875	.15
Chicago	150.00‡	60.00e‡	2.85/4.00d	15.00	23.50	14.15g	22.65g	.0625h	.155h	.05	.09/.10‡	.13/.15‡
Cincinnati	120.00	55.75	.....	17.00	.....	.085	.....	12.25	.....	.07	.085	.....
Cleveland	127.50	39.00	3.87	17.00	19.00	.085	.085	.10h	.11	.08	.....	.....
Dallas	.....	40.00	.....	15.36	22.70	.0618	.12	17.95	28.00	.06	.0725	.135
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	75.00t	.....	17.60f	26.56f	.0734	.128	.0718h	.119h	.067	.0974	.135
Kansas City	.....	40.00	.....	15.00u	20.60u	15.00g	.....	.07h	.0675hu	.....	.11	.15u
Los Angeles	.....	50.00	.....	9.00b	23.00b	9.50bg	24.00bg	9.50bg	.....	.03b	.08b	.16b
Minneapolis	.....	.....	2.017d	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montreal	70.00	.....	.....	16.60k	24.25k	.1035k	.111k	.115kk	.135kk	.08k	.135k	188k
New Orleans	.....	.....	.....	13.00x	.....s	12.00g	.....s	5.75	.....s	.05	.....	.....
New York	.....	65.00	.....	18.40	28.25s	.0734t	29.20g	.0746h	.1248h	.0671	.0754	.1259
Philadelphia	150.00	62.00	4.06	16.00	.....	15.00	.....	.0675h	.....	.....	14.00gr	.....
Pittsburgh	135.00	39.75	3.75	19.00	25.00	.095	.17	21.00	38.00	.075	.085	.14
St. Louis	.....	40.00	.....	14.80	19.80	13.80g	18.80g	.0587h	.1362h	483	.07	.1215
San Francisco	.....	45.00e	.....	11.75	21.00	11.75g	.....	13.75	.....	.....	.0525	.1125
Seattle	.....	.....	.....	11.75i	22.75i	9.50	21.20gi	12.25i	14.75	11.75i	.0525i	.0625i

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 2½ × 8½ × 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ × 4 × 8½. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martines. *j* 3 x 3½ x 8½ in. *k* Tax included. *l* Quoted on request only. *m* Per thousand. *r* February 1943 prices, none later available. *s* Drums not available. *t* Very scarce. Truck deliveries in small quantities.

Users report tire life almost tripled with this new type construction

WHEN an operator's records show an average of 4571 hours per tire — compared to 1600 from another make — that's news that can mean real money-savings for you. The tires that set that record were B.F.Goodrich Universals, like those pictured above. And here's the story back of it.

B.F.Goodrich engineers studied the problems of traction and bruising — found the answers. First, they designed a tread with thick, heavy lugs that protect the undertread. But they designed the tread so that the natural running action pushes mud and dirt toward the edges. The tire gives first-rate traction in *either* direction. It stays clean, resists side slippage.

Then, an entirely new construction principle was developed — the *shock shield*. This shield is a set of four breakers—layers of rubber-coated rayon cords — built in between the tread and the plies. These breakers are in pairs, with the cords in each pair running parallel to each other, but with each pair running in opposite directions to give balanced strength. The breakers are cushioned with thick layers of special shock-resistant rubber.

Under impact, the cords in the breakers stretch together, *not* across each other, and return to their original position. The blow is *distributed* and absorbed by the rubber cushions; the shock passed on to the cord body is greatly reduced.

Users of Universals and of other B.F.Goodrich off-the-road tires built with shock-shield protection report fewer bruises, lower repair bills, longer wear, and say that more tires can be retreaded. Find out how these tires—designed to meet your needs — can make greater savings for you. See the B.F.Goodrich dealer, or write us direct. *The B.F.Goodrich Company, Akron, Ohio.*

Truck Tires BY

B.F. Goodrich

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Net Ton Standard	STEEL RAILS Per Net Ton Light	STEEL RAILS Per Net Ton Re-rolled	TRACK SUPPLIES Angle Bars	TRACK SUPPLIES Std Spikes *c*	TRACK SUPPLIES Tie Plates *c*	TRACK SUPPLIES Track Bolts
Birmingham	$2.35	$2.35	$3.75	$3.25	....	$43.39	$49.18	$48.29	$2.70	$3.65	$2.55	$4.75
Chicago	2.35	2.35	3.75	3.25	$2.65	43.39	49.18	48.29	2.85	3.65	2.55	4.75
Pittsburgh	2.35	2.35	3.75	3.25	2.65	43.39	49.18	48.29	2.85	3.65	2.55	4.75
Buffalo	2.35	2.35	....	....	2.65	.....	.....	.....	....	....	2.55	....
Cleveland	.....	2.35	3.75	3.25	....	.....	.....	.....	....	....	....	....
Youngstown	....	2.35	....	....	....	.....	.....	.....	....	3.65	....	....
Detroit	....	2.45‡	....	....	....	.....	.....	.....	.....	....	....	....
Gulf ports	2.60*a*	2.70*a*	....	....	2.85*a*	.....	.....	.....	....	....	....	....
Pacific ports	3.00*a*	2.75*a*	....	3.75*a*	3.20*a*	.....	.....	.....	....	3.90	2.70	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone. Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per car.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb base price	REINFORCING BARS *g* Per 100 lb., ¼ in. base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per 100 s. f.	SHEET PILING Per 100 lb. base price
Atlanta	$4.05‡	$4.12‡	$4.12‡	$.025	$.10	$23.16	$25.30	$1.95	$1.45	$2.05	$3.35
Baltimore	3.909	3.344	....	....	.10	24.50	26.50	1.83	1.37	1.93	3.25
Birmingham	2.35*a*	2.15	2.15	.025	.10	19.00	21.00	1.93	1.44	2.03	....
Boston	4.162‡	4.194‡	2.97*c*	$20 C.L.	.10	18.50	20.50	1.89	1.41	1.98	3.02
Chicago	2.35*a*	2.35*a*	2.35*a*	.03	.05	21.50‡	23.50	1.80	1.35	1.89	2.65
Cincinnati	3.841	2.86*cd*	2.86*cd*	....	.05	....*n*	....*n*	1.79	1.35	1.88	....
Cleveland	3.838	4.00	3.98	.025	.10	20.50	24.50	1.79	1.35	1.88	....
Dallas	5.25	4.17	4.17	....	....	25.50	27.50	2.06	1.52	2.17	....
Denver	4.83	4.54	....	....	....	35.00	35.00	2.10	1.55	2.21	....
Detroit	3.911‡	2.70‡	2.70‡	....	.10	34.00‡	37.00‡	1.81	1.36	1.90	2.91
Kansas City	4.44	2.75*cd*	2.75*cd*	.0	.05	29.50	31.50	1.91	1.43	2.01	3.062
Los Angeles	4.45*f*	3.025	2.875	.03	.05	23.00	27.50	2.06	1.52	2.17	4.45
Minneapolis	4.122‡	2.99	2.99	.0	.10	25.00	27.00	1.93	1.44	2.03	3.04*d*
Montreal	3.95*i*	3.25*i*	3.15*i*	....	....	31.00*hi*	46.00*hi*	2.89	3.54*i*	2.96*im*	....
New Orleans	4.408‡	3.84	4.108	.05	.10	22.00	24.00	1.95	1.45	2.05	3.125
New York	4.008	2.96*c*	2.96*c*	....	.15	17.50	19.50	1.85	1.39	1.95	2.74
Philadelphia	3.916	3.868	....	....	....	20.50‡	22.50‡	1.84	1.38	1.93	2.97
Pittsburgh	2.35*a*	2.35*a*	2.35*a*	.025	.10	23.00	26.50	1.72	1.30	1.81	2.65
St. Louis	3.381	2.94	2.94	.0	.05	28.00	34.00	1.82	1.37	1.92	....
San Francisco	4.40	3.025	2.875	.025	.10	22.00	25.50	2.06	1.52	2.17	3.30
Seattle	3.00*e*	3.00*e*	....	....	....	36.50	38.00	2.06	1.52	2.17	3.20*e*

‡ Delivered *a* Mill prices *b* 5–15 tons, add 15c 1–5 tons, add 25c Less than 1 ton, add 50c. *c* 20 tons or over Base *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *m* Per sq. yd. *n* Practically no carloads are available. Retail price delivered is $27.00 for std. diamond mesh and $29.00 for std. ribbed.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, std 8 in., s.s.	Delivered std 12 in., s.s.	ASTM 24 in.	C13–35 36 in.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b 6 in.	8 in	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv %	3½ to 6 in.: Lap Weld Black %	Galv. %
Atlanta	$61.40	$0.43	$0.67	$3.39	....	$110.00	$140.00	$0.45	$2.00	65.5	54.5	63.5	53.0
Baltimore	65.80	.35	.60	2.70	$7.25	160.00	200.00	.85	2.25	65.5	57.5	63.0	54.5
Birmingham	57.00	.275	.495	1.95	5.50	100.00	220.00	.50	1.75	62.5	54.2	59.7	51.2
Boston	68.00	.392*r*	.756*r*	3.15*r*	7.995*r*	170.00‡*r*	265.00‡*r*	.53	2.04	....	....	....	....
Chicago	65.80	.44	.85	3.37	7.00	110.00‡	150.00‡	.45	1.85	63.0	52.0	61.5	50.0
Cincinnati	64.80	.308	.594	3.42	8.20	97.30	149.40	.36	1.60	51.5	39.4	51.4	36.0
Cleveland	66.20	.226*r*	.513	2.15	5.535	138.50	216.60	.36	1.60	68.5	57.5	66.0	54.5
Dallas	67.78	.365	.657	2.664	6.00	108.00	130.00	.46	1.75	65.5	54.5	63.0	51.5
Denver	72.62	.34	.612	2.52	....	154.00‡	264.00‡	.52	2.00	44.0*s*	30.25*s*	40.5*t*	25.25*t*
Detroit	66.20	.42	.81	3.15	8.50	170.00‡*r*	263.00‡*r*	.36	1.60	54.1	40.3	50.9	36.5
Kansas City	67.12	.35	.64	2.40	6.70	170.00	308.00	.45	1.60	60.5	49.5	57.8	46.3
Los Angeles	79.00	.361†	.648†	2.988	7.47	130.50	217.50	1.00†	2.00†	....	....	....	....
Minneapolis	69.10	.361*x*	.751*x*	2.645†*x*	....	....	....	.90	2.40	60.6	49.6	57.9	46.4
Montreal	70.00	.85*o*	1.50*o*	5.25*p*	8.50*rp*	45.00*m*	64.00*m*	.811*m*	2.51*m*	....	....	....	....
New Orleans	63.40	.31	.558	3.558	....	112.00	....	....	....	58.8	47.8	56.3	44.8
New York	65.20	.46	.89	3.67	9.08	....	....	.60	1.40	61.9	50.9	59.4	47.9
Philadelphia	63.90	.385	.75	3.06	8.00	180.00	250.00	.45	1.75	52.75	39.01	49.63	35.25
Pittsburgh	66.60	.322†*r*	.631†*r*	2.7†*r*	6.625*r*	124.20	193.80	.99	2.25*g*	65.6*i*	54.2*i*	63.0*i*	51.2*i*
St. Louis	64.40	.31*w*	.558*w*	2.232*w*	4.95*w*	93.50*w*	187.00*w*	1.00*j*	2.15*k*	64.5*s*	53.5*s*	63.0*t*	51.5*t*
San Francisco	79.00	.3875*t*	.6975*d*	2.79	6.975	124.50	207.50	.58	2.34	....	....	....	....
Seattle	80.80	.4125	.77	2.98	....	115.20	....	.51*f*	1.44*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, Burlington, N. J. (base) $59.00. Based on existing freight rates; subject to rate change. Gas pipe and class A $3 per ton additional, 4 in., $5 per ton additional, 30 in. and larger usually $1 per ton less. *b* Double strength. *d* List. *e* 30-inch *f* Less 5% for cash *g* Culvert pipe *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in. 8½c.; ¾ in., 11½c.: 1 in., 17c.: 2 in. 37c., 2½ in., 58½c.: 3 in., 76½c., 4 in., $1.09: 6 in., $1.92; 3 per cent tax on transportation costs not included. *i* Applies also at Lorain, Ohio mills. Chicago delivered base is 2½ points less on butt, 1¼ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt-weld—1 in. and 1¼ in. black 34 galv 16; 1½ in. black 38 galv 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in. black 31½ galv. 14½; 4½ in.: to 8 in. black, 32½ galv. 17. *j* Reinforced; spec. C 76-37. *k* Reinforced; spec. C 75-37. *m* Centri. spun. *o* Less 50%. *p* Less 53%. *r* Truck delivery. *s* Gary base *t* Morain base. *w* Less 3% for cash. *x* Price previously quoted was for carload lots. Since carload lots are not available at this time, listed price is based on LCL (no minimum).

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	All Fir planks No.2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)												
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 R.L.	6x12 R.L.	12x12 R.L.	2x12 R.L.	12x12 R.L.	¼"	¼"
Atlanta	**$45.25**	**$45.25**	**$42.25**	**$41.75**	**$42.75**	**$45.25**	.....	.....	.....	$67.00	$67.00	$17.72	$21.37
	68.50	*68.50*	*61.00*	*61.00*	*60.00*	*60.00*	*54.00*	*53.50*	*52.50*	.....	.....	.....	.....
Baltimore	**72.50**	**74.00**	**69.50**	**69.00**	**69.00**	**75.00**	**$85.00**	.....	.....	181.00	175.00	18.45	21.995
	79.00	*80.00*	*78.50*	*72.00*	*77.00*	*78.00*	*92.00*	*$85.00*	*$83.00*	.....	.....	.....	.....
Birmingham	**50.00**	**50.00**	**49.50**	**48.50**	**49.50**	**52.50**	**73.00**	.....	.....	.....	.....	17.245	20.795
	55.00	55.00	54.50	53.50	54.50	57.50	77.00	60.00	61.00	72.50	75.00	.....	.....
Boston	**69.00**[a]	**71.00**[a]	**65.25**[a]	**67.25**[a]	**69.25**[a]	**73.25**[a]	**69.00**[a]	.....	.....	.....	**58.00**[a]	18.195	21.995
	63.50	*63.50*	*61.50*	*62.00*	*61.50*	*61.50*	*59.00*	*58.00*	*58.00*	*58.00*	*68.00*	.....	.....
Chicago	**65.00**	**66.00**	**62.00**	**62.00**	**62.00**	**69.00**	**75.00**	.....	.....	97.00	97.00	14.555	17.555
	65.50	*65.50*	*65.50*	*65.50*	*65.50*	*66.50*	*67.50*	*63.00*	*64.00*	.....	.....	.....	.....
Cincinnati	**51 00**	**52 50**	**46.00**	**46.00**	**48.00**	**56 00**	**70 50**	.....	.....	68.50	68.50	17.245	20.795
Cleveland	**58.50**	**58.50**	**56.50**	**55.50**	**56.25**	**58.25**	**65.00**	.....	.....	.....	91.75	17.615	21.265
	64.50	*64.50*	*58.50*	*54.50*	*54.50*	*55.75*	*63.75*	*58 75*	*57 75*	.....	.....	.....	.....
Dallas	**54.50**	**54.50**	**52.75**	**51.75**[j]	**52.25**	**54.00**	**56 50**	**59.50**	**59.50**	89.75	86.00	14.555	17.555
Denver	**64.25**[i]	**64.25**[i]	**64.75**[i]	**65.25**[i]	**63.75**[i]	**64.75**[i]	**68.75**[i]	*72.60*	*72.25*	.....	.....	10.285	12.435
Detroit	**62.00**	**62.00**	**58.75**	**58.75**	**58.75**	**64.00**	**71.00**	.....	.....	70.75	90.00	17.245	20.795
	63.50	*63.50*	*62.50*	*62.50*	*67.25*	*77.25*	*79.50*	*76.00*	*90.00*	.....	.....	.....	.....
Kansas City	**76.00**	**76.00**	**74.00**	**72.75**	**73.25**	**76.00**	**95.00**	.....	.....	95.00	100.00	12.605	15.205
	78.00	*78.00*	*77.50*	*77.50*	*75.50*	*77.00*	*84.50*	*95.00*	*95.00*	.....	.....	.....	.....
Los Angeles	*64.75*	*64.75*	*68.50*	*67.25*	*67.25*	*67.25*	*76.00*	*75.25*	*73.50*	.....	.....	9.81[g,h]	11.86[g,h]
Minneapolis	**78.50**[a]	**77.25**[a]	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.765	16.615
	84.00	*84.00*	*78.25*	*78.10*	*77.25*	*79.00*	*73.25*	*77.25*	*76.25*	.....	.....	.....	.....
Montreal	**69.00**	**70.00**	**64.00**	**68.00**	**70.00**	**75.00**	...	.....	...	.20[k]	.20[k]	.....	...
	97.00	*97.00*	*97.00*	*97.00*	*97.00*	*97.00*	*87.00*	*87.00*	*87.00*	.....	.....	.....	...
New Orleans	**42.00**	**42.00**	**39.00**	**38 50**	**34.00**	**42.00**	**46.00**	.....	.....	54.50	69.00	14.555	17.555
	86.00	*86.00*	*84.50*	*84.50*	*53.50*	*53.50*	*53.00*	*22.50*	*29.50*	.....	.....	.....	.....
New York	**Range from $85.00 to $95.00**						**$95 to $100**	.....	.....	125.00[f]	130.00[f]	18.195	21.995
	Range from $91 to $121									.....	.....	.....	.....
Philadelphia	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	.....	.....	130.00	130.00	18.195	21.995
	80.50	*80.50*	*79.50*	*79.50*	*79.50*	*79.50*	*89.50*	*90.00*	*90.00*	.....	.....	.....	.....
Pittsburgh	**55.40**	**57.80**	**67.35**	**59 60**	**65.45**	**67.10**	**80.85**	.....	.....	126.00	137.00	17.88	21.63
	73.60	*72.70*	*70.70*	*69.90*	*69.80*	*70.35*	*87.35*	*92.85*	*92.85*	.....	.....	.....	.....
St. Louis	**71.00**	**71.00**	**70 00**	**68.75**	**69.50**	**71.75**	**79.75**	*79.00*	*77.75*	105.75	103.00	14.555	17.555
San Francisco	*65.50*	*65.50*	*61.50*	*61.50*	*60.50*	*60.50*	*55.25*	*54.25*	*54.25*	...	...	7.33[g]	8.83[g]
Seattle	*60.00[a]*	*60.00[a]*	*52.25[a]*	*52.25[a]*	*51.00[a]*	*51.00[a]*	*60.75[a]*	*52.75[a]*	*57.75[a]*	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf [2] Roofers N. C. Pine [3] Spruce [4] Native. [5] Western Pine, No 3 Common [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *c* 5M ft. or less. *d* New series—sales through wholesale distribution yard (F.o.b. purchaser's truck or carrier, San Francisco paid). For relation to mill prices formerly carried, see Lumber price report ENR (Vol. p. 944) June 13, 1946. *e* Plus sales tax. *f* Up to 18 ft. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* FBM, scarce, no stable quotation, no ceiling. *j* Price last month should have been quoted $1.75.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq ft surface. Seattle base price on ¼", $95.15; on ⅜", $104.85; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness A quality	B quality	EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
Atlanta	74%	75%	$0.16	
Baltimore	78%	79%	.16	
Birmingham	76%	76%	.115	
Boston	77%	78%	.16	
Chicago	77%	77%	.16	
Cincinnati	77-10%	77-10%	.16	
Cleveland	77%	77%	.20	
Dallas	76%	76%	.167.5	
Denver	76%	76%	.165[e]	
Detroit	77%	77%	.1675	
Kansas City	77-10%	77-10%	.165	
Los Angeles	86%[d]	88%[d]	.1675	
Minneapolis	77%	77%	.16	
Montreal	40-10-2%[a,b]	50-2%[a,c]	.1775†	
New Orleans	70%	75%	.17	
New York	80%	81%	.23[f]	
Philadelphia	78%	79%	.16	
Pittsburgh	79%	79%	.1325	
St. Louis	77-10%	77-10%	.165	
San Francisco	66%	73%	.165	
Seattle	75%	75%	.1675†	

Price of 60% Ammonia Gelatin is $0.01 per lb higher than 40%

a Discount from list Sept. 1939: sales tax included, but 6% tax exemption not allowed for *b* Single thickness *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1938

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal St. add delivery charge of $6.00 per trip † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me	$0.115	$0.14	$0.16
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.12 -.1275	.145 -.1275	.165 -.1775
Rocky Mtn. States	.12 -.1325	.145 -.1625*e*	.165 -.1825*e*
Pacific N. W. States	.1175-.13	.1475-.16	.1675-.18
Pacific S. W. States	.1150-.1225	.145 -.1525	.165 -.1725

e F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES F.O.B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk

Dimensions	Points	Length	By Rail — Pine *	Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	.....
12 in — 2 ft. from butt	6-in.	50 to 59-ft.	.35	.....
12-in — 2 ft. from butt	6-in.	60 to 69-ft.	.36	.....
12-in — 2 ft. from butt	6-in.	90 to 100-ft.	...	.54
13-in — 3-ft. from butt	5-in.	91 to 100-ft.	...	.56
14-in — 2-ft. from butt	6-in.	50 to 69-ft.	.41	.63
14-in — 2-ft. from butt	6-in.	70 to 79-ft.	.43	.57
14-in — 2-ft. from butt	5-in.	80 to 85-ft.	.54	.....
14-in — 2-ft. from butt	5-in.	85 to 89-ft.	.57	.....
14-in — 2-ft. from butt	5-in.	90 to 100-ft.	...	.62

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

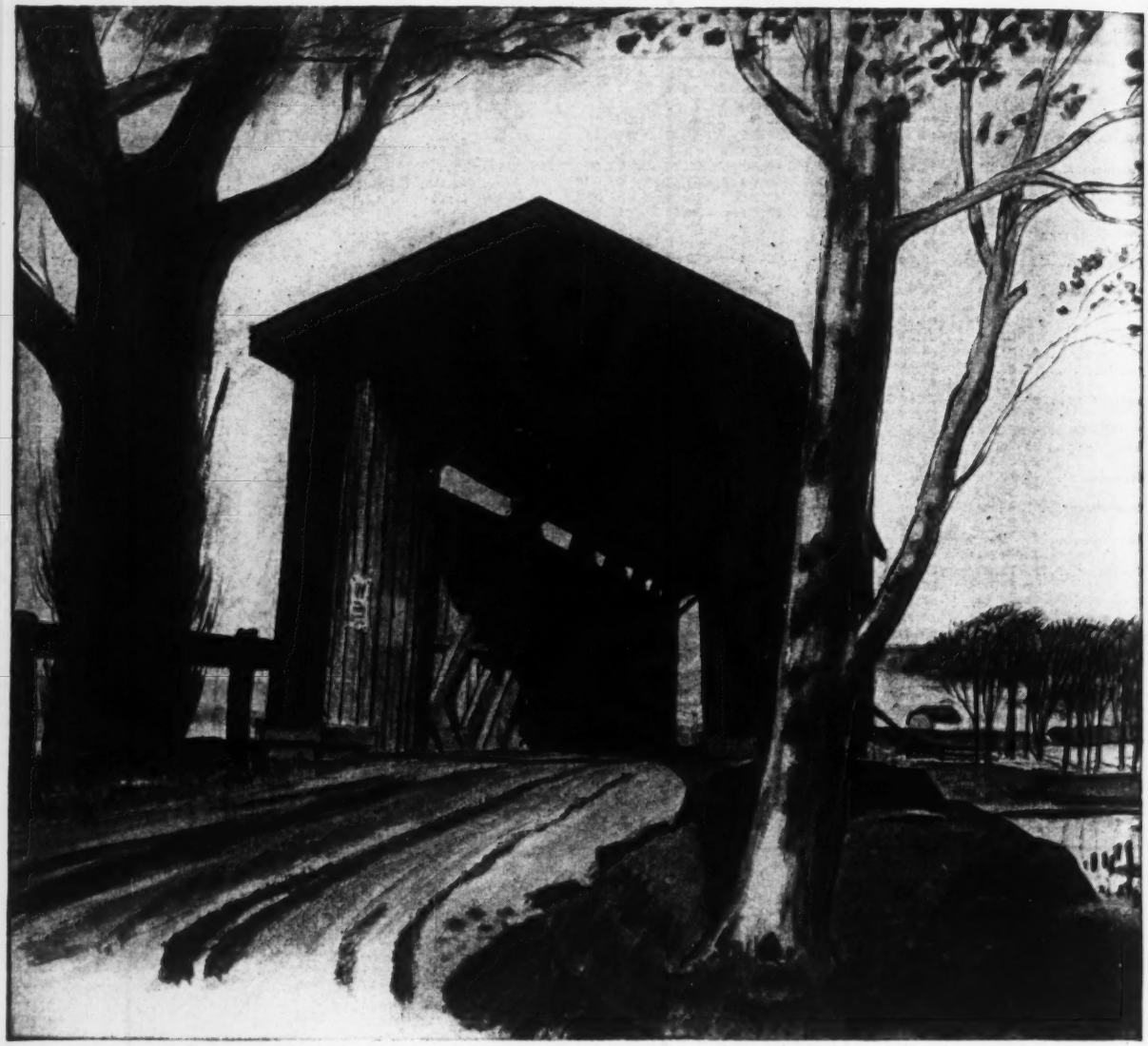
Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.50	....	$2.00	....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.43/1.54	2.59	1.76	2.86
	Mixed Oak	1.71	2.59	2.42	3.58
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.45/2.65*a*	....	3.35/3.60
Los Angeles	Douglas Fir	2.10	3.35*a*	3.00	4.80*a*
Philadelphia	Red Oak	....	2.10*a,g*	....	3.25*a,g*
St. Louis	White Oak	1.70	....	2.40	....
	Red Oak	1.63	2.15*a*	2.19	3.25*a*
	Sap Pine or Cypress	1.70	....	2.06	....
San Francisco	Douglas Fir	1.25*b,e,f*	....	....	3.00*a,f*
Montreal	Birch or Maple	....	1.65	1.04	....

Tr — Treated; Untr — Untreated *a* Creosoted *b* 6"x8"x8'6". *c* Empty cell *d* Zinc *e* Green *f* F.o.b. cars † Out of market *g* January 1943 price, none later available

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.50- 3.10
Chlorine cylinders, liquid, per lb., delivered	.0525
Calcium chloride, 77-80% flaked 100-lb paper bag, del'd, ton	18.50-35.00
Silicate of soda, 52 deg. in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb, dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00-25.00
Sulphate of copper, in bbl., per 100-lb	5.00

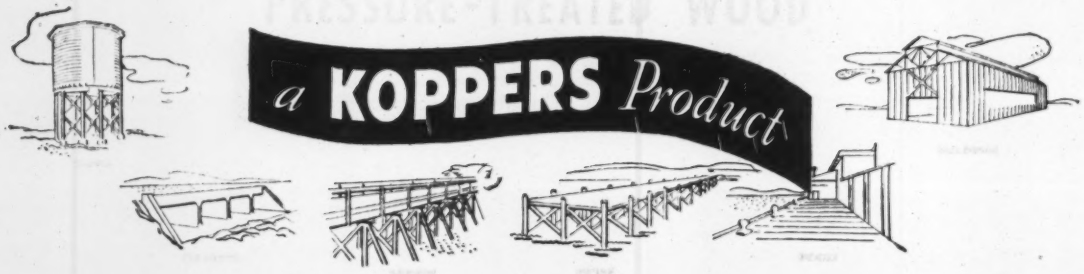


Why did old bridges carry umbrellas?

The covered bridges that once dotted the highways of the country weren't built to protect the traveler . . . but the bridge itself. By shielding the trusses, decking and stringers from moisture—which permits the fungus growth that causes decay—the life of the bridge was extended.

Today there is the same necessity of protecting not only bridges, but all sorts of structures from the accelerated decay produced by moist conditions: building frames, roofs and walls in humid atmospheres; timbers and flooring laid at grade or subgrade; piling and piers.

Koppers pressure treatments are available that give lasting, proven protection against decay, termites and marine borers. Some resist acid attack, others confer fire-retardent properties. Our bulletin, "Economical and Permanent Construction with Pressure-Treated Wood" gives details. Ask for a complimentary copy. Wood Preserving Division, Koppers Company, Inc., Pittsburgh 19, Pa.



STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M lots of 2,000 pieces or over 8x12x12 in	10x12x12 in	12x12x12 in.	BRICK Per M in quantity Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized, or lump
Atlanta	$110.00	$130.00	$230.00	$240.00	$270.00	$300.00	24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	90.00	95.00	175.00	200.00	260.00	300.00	23.75*k*	29.75*k*	20.00	15.00	2.50*m*
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	18.50	23.00	18.11	14.05	15.05—18.95
Boston	105.00†	112.00†	210.10†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	92.10	98.40	185.20	.....*x*	.....*x*	.....*x*	17.00	18.00	17.50	15.00	12.50
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	27.75	27.75	15.50	13.00	.....
Cleveland	98.10	104.56	.....*x*	.....	.....	.....	22.75	22.75	15.75	13.75	.....
Dallas	77.25	83.00	165.00	198.00	254.50	315.00	17.25	19.00	19.00	15.00	15.00
Denver	105.20	119.00	198.25	230.00	263.50	315.25	24.00	.....	30.00*y*	24.00*f*	26.00
Detroit	92.70	96.70	174.50	198.80	257.20	294.30	23.25*f*	23.25*f*	20.00	18.00	18.00
Kansas City	67.00	69.00	89.00*c*	128.00	163.00	189.00	17.50	18.50	19.32	13.00	10.92
Los Angeles	82.50†*r*	97.50†*r*	135.00*c*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	16.50	18.50	16.50	17.50	17.50
Minneapolis	.....	112.00*b*	186.25*b*	112.00*aa*	.....	.....	18.50*g*	.....*g*	26.00*bb*	16.00*bb*	19.00*bb*
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*a*	.....	294.40*a*	22.16†*u*	29.41†*u*	18.00*u*	15.00*u*	14.00*u*
New Orleans	104.50	109.55	207.25	222.25	326.90	385.65	17.75	.....	18.30	12.08	14.10
New York	99.40*s*	106.00*s*	145.75*c*.*s*	156.60*hn*	.....*x*	.....*x*	23.00	.....	20.00	14.00	17.00
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	20.75	23.75	22.00	18.00	17.00
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	23.25	25.25*y*	19.40*cc*	16.90*cc*	2.55*m*
St Louis	.....	.....	.....	.....	.....	.....	23.50*s*	22.50*s*	22.00*s*	18.00*s*	.....*x*
San Francisco	102.40	115.20	153.60	115.20*x*	.....	.....	21.00	.....	19.70	19.70	1.97*m*
Seattle	121.00	133.00	.....*x*	133.00*cc*	.....	.....	22.50*k*	27.75*k*	20.00*s*	20.00*s*	3.00*m*

† F.o.b. *a* Smooth *b* Carload lots delivered to job. *f* Includes $3.50 per M. for delivery. *g* No quotation. *h* F.o.b. Perth Amboy N. J. *i* F.o.b. Warehouse only. *j* OPA Price *k* $1.00 discount. *m* Per bbl., 180 lb. *n* 7¼ x 7¼ x 12 Speed tile. *o* Per bbl., 200 lb. *r* 5% discount 10 days. *s* 2% discount for cash. *t* 5½ x 8 x 11½. *u* 8% sales tax included *v* sand lime. *x* Not available. *y* Stacked. *z* Subject to 20—25% increase. *aa* 5 x 8 x 12 in. *bb* LCL delivered. *cc* Truck delivery

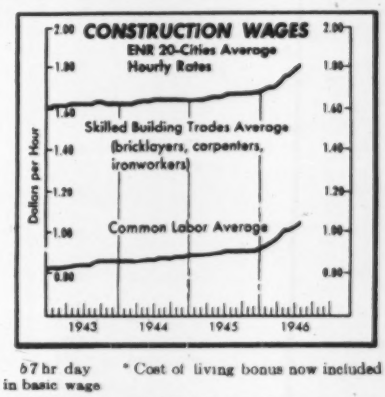
PAINT, ROOFING — F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b., factory Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$12.00	$15.375	$1.30	$2.25	$1.20	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	11.75	15.00	2.00	3.00	2.50	2.35	2.90	2.90	.40	29.00
Birmingham	12.00	15.375	2.25	3.53	1.98	2.09	1.98	1.98	.32	28.35
Boston	11.75	15.00	1.75	2.50	2.31	2.00†*h*	3.30†*ur*	3.30†*ur*	.25†	21.00†
Chicago	11.75	15.00	.....	.....	.....	1.75*h*/	1.99*h*/	1.99*h*/	.33/	23.00/
Cincinnati	11.75	15.00	1.70	2.90	1.60	2.20	2.10*h*	2.10*h*	.33	25.00
Cleveland	11.75	15.00	.....	.....	.....	1.80	1.71*h*	1.71*h*	.237	25.00
Dallas	11.75	15.75	1.88	.....	.06*l*	1.75*h*	1.66*h*	1.66*h*	.35	39.00
Denver	11.75	15.50	1.80	13.2*k*	16.15*k*	3.00	1.92*h*	1.92*h*	.29	29.00
Detroit	11.75	15.00	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	11.75	15.125	2.30*g*	2.55*g*	2.16*g*	2.19	2.30	2.30	.28	27.50
Los Angeles	12.00	15.50	2.00	2.60	2.50	2.10	1.50	.....	.45	.....
Minneapolis	11.75	15.125	.....	.....	.....	1.7123*i*	1.6243*hi*	1.6243*hi*	.32	23.00
Montreal	.....	12.30	2.50*p*	4.90*p*	3.15*p*	2.71	2.45*t*	2.45*t*	.84*t*	1.83*kt*
New York	11.75	15.00	2.03	.....	1.82	1.9006	1.8468*o*	1.8468*o*	.26	23.00
Philadelphia	11.75	15.00	1.60/1.80	2.20	1.55	2.25	2.71	2.71	.32	23.00
Pittsburgh	11.75	15.00	1.75	2.20	1.60	2.15	2.09*h*	2.09*h*	.34	26.00
St. Louis	11.75	15.00	2.28*s*	2.89*s*	1.96*s*	1.71*h*	1.70*h*	1.70*h*	.38	22.00
San Francisco	12.00	15.25	1.80	2.75*n*	1.35	1.7613	2.72	2.72	.3399	21.115
Seattle	12.00	15.50	1.90	3.00	.....	2.15	2.16*h*	.....	.35	31.00*j*

‡ Delivered Note: Red lead in oil 50c higher than white lead in oil *a* Red lead prices change frequently due to pig lead price changes *b* U. S. War Dept. Spec. 3-49A *c* ASTM Spec D266-31 *d* 80% minimum ferric oxide *f* Distributors' price to contractors *g* 55 gal. can *h* Per roll, 65 lb. *i* Minneapolis and vicinity *j* Asphalt pitch *k* Per 100 lb. *l* Per lb. *n* May, 1941 price *o* 60-lb. roll. *p* Plus 8% sales tax. *s* December, 1942 price. *t* Federal tax included *u* 90-lb. roll. *v* Truck delivery.

SKILLED AND COMMON WAGE RATES — PER HOUR

	Brick-layers	Car-penters	Struct. Iron Workers	Hoisting Engineers	Plas-terers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.75	$1.50	$1.625	$1.50	$1.62	$0.65	$0.80
Baltimore	1.90	1.675	1.90	1.625/2.00	1.725	.95	.95
Birmingham	1.9375	1.50	1.625	1.50	1.65	.65	.65
Boston	1.725	1.60	1.85	1.65	1.667	1.15	1.15
Chicago	2.00	1.95	1.88	1.95	2.00	1.30	1.30
Cincinnati	1.875	1.65	1.775	1.875/2.125	1.875	.95	.95
Cleveland	2.00	1.65	2.00	2.00	2.00	1.25	1.25
Dallas	1.9375	1.425	1.625	1.625	1.75	.80	.80/1.25
Denver	1.80*b*	1.625	1.50*b*	1.625*b*	1.90	1.00	1.00
Detroit	1.90	1.75	1.825	1.675/1.825	1.90	1.15	1.15
Kansas City	2.00	1.75	1.875	1.875	2.00	1.175	.90
Los Angeles	2.00	1.65	1.90	1.65	2.05	1.25	1.25
Minneapolis	1.825	1.65	1.75	1.60	1.725	1.15	1.15
New Orleans	1.625	1.375	1.625	1.55	1.625	.70	.80
New York	2.25*b*	2.10*b*	2.25	2.25*b*	2.25*b*	1.25	1.20
Philadelphia	2.00	1.775	1.90/2.00	2.25	2.00	1.025	1.025
Pittsburgh	2.00	1.75	1.75	1.875	1.875	1.60	.90
St. Louis	2.00	1.95	2.00	2.20	1.90	1.20	1.20
San Francisco	2.05	1.75	2.00	1.60/2.00	2.00	1.25	1.25
Seattle	1.975	1.675	1.80	1.90	1.975	1.275	1.275
Montreal*	1.16	1.02	1.07	1.07	1.12	.61	.66



b 7 hr day * Cost of living bonus now included in basic wage

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.8114

ENR Common Average: $1.0581

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Truck Tire

Made specifically for operations off as well as on the highway, a new tire, Hi-Way Lug, has deep, non-skid and extra heavy tread, plus strength in the rayon cord body, for cut and bruise protection as well as traction.

The lugs are placed close together; alternate long and short bars are said to provide extra traction. Specially compounded rubber contributes to the tire's toughness, and heavy rayon breakers tend to minimize shearing action between tread and carcass. Tires will be available in 9.00, 10.00 and 11.00-20 sizes.—*The Goodyear Tire & Rubber Co., Akron, Ohio.*

• • •

Foundation Form

A "ready-to-use" foundation form is said to reduce forming time and cost to a minimum by providing faster erection, alignment on one side only and easier stripping. Made of steel, this form is welded into a rigid frame with ¾-in. plywood facing. Furnished in 2x8 and 2x6 ft. sizes, the form is complete and requires no assembly of parts. A standard Uni-Form tie is used.

Steel angles have milled slots for ties to prevent seepage and assure tight forms and smoother concrete surfaces. Other features claimed for this form are rigid outside corners; simple method of forming inside corners and pilasters; 40 to 60 re-uses of panels before turning or replacement of plywood, and another 30 to 50 uses on the turned face.—*Universal Form Clamp Co., 1238 North Kostner Ave., Chicago 51, Ill.*

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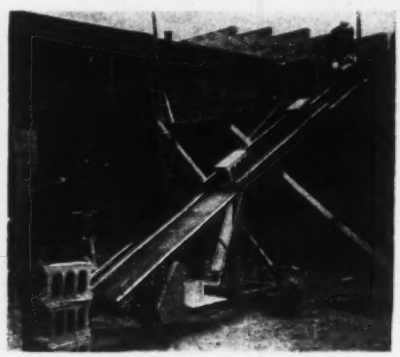
Portable Conveyor

Handipiler, an electrically operated portable conveyor conveys, elevates and stacks cases, blocks, brick, etc., quickly and easily, it is claimed. The adjustable



boom is clear of all supporting obstructions; it extends up to 10½ ft. in height and stacks as high as 14 ft. The conveyor handles individual items weighing up to 100 lb.

The ruggedly built Handipiler is light weight for easy portability and is ready to go to work when plugged into any AC or DC circuit.—*Standard Conveyor Co., North St. Paul, Minn.*

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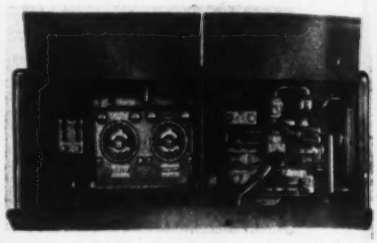

Gas Drive Welder

Two operators can work independently of each other with a gasoline engine driven arc welder, it is announced. The machine has been developed by placing two 300-ampere generators on a common shaft, supplied with separate excitation from a common exciter. The engine is governed to maintain constant speed for all loads, and a paralleling switch is also provided to turn the unit into a single-operator 600-ampere unit.—*The Hobart Brothers Co., Troy, Ohio.*

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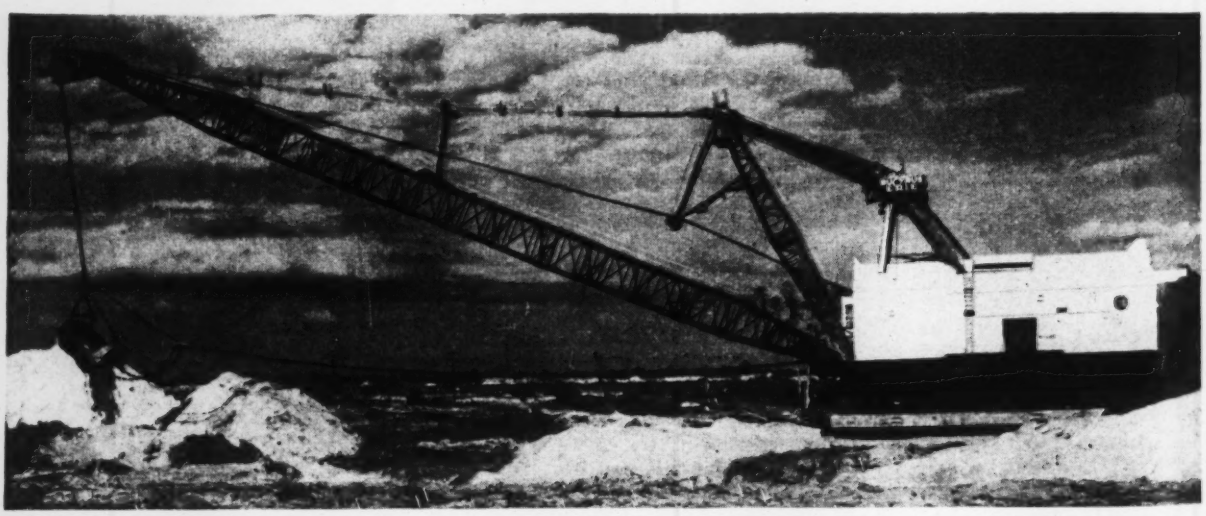
Pneumatic Impact Wrench

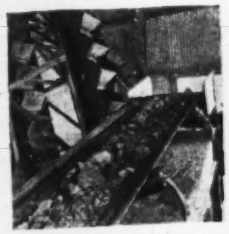
Now ready for delivery, the Thor pneumatic impact wrench for driving and removing nuts, bolts and cap screws up to ¾ in. thread size, is said to be the



The 1150-B is the largest capacity walking dragline offered by Bucyrus-Erie Company. Here is a machine adaptable to deep stripping of mineral or coal deposits, levee work and other operations requiring a long boom reach. It is offered for electrical operations and has Ward-Leonard, variable voltage, rotating control. With a 180-ft. boom this dragline swings a 25-cu-yd. bucket. And, with a 250-ft. boom, it will handle a 14-cu.yd. bucket.

The Jeffrey Book of Experience Is Open To Your

MATERIAL HANDLING PROBLEMS


BELT CONVEYORS

SCRAPER CONVEYORS

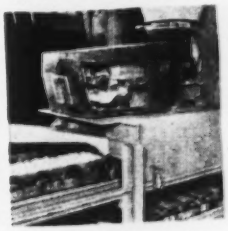
BUCKET ELEVATORS

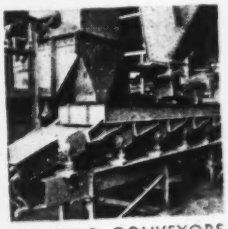
APRON CONVEYORS

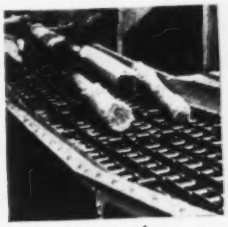
CRUSHERS-PULVERIZERS

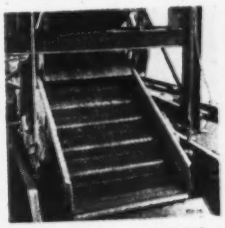
SPIRAL CONVEYORS

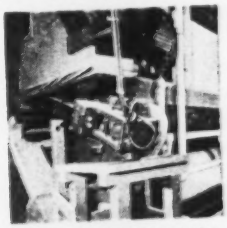
VIBRATING FEEDERS


WAYTROL FEEDERS


VIBRATING CONVEYORS


CHAINS


VIBRATING SCREENS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You'll search a long time to find an instrument comparable to this Leupold product. Men who use it confirm our belief that all requirements are conveniently incorporated in this one accurate, moderately priced level.

Telescope is external focusing, 13 inches long, with 1¼ inch objective; achromatic lens with a flat field and magnification of 18 diameters . . . Horizontal circle for turning angles and two auxiliary standards to which the telescope may be shifted for plumbing vertical lines . . . Instrument weight—8 lbs. Tripod weight—7 lbs . . . Hardwood carrying case.

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smallest and lightest of its class. It weighs 3¾ lb. and is 5⅞ in. long.

Rotatively striking impact jaws are set at a wide radius from the spindle center to reduce stress, and a short, rigid spindle shank delivers the blow close to the work. —*Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago 6, Ill.*

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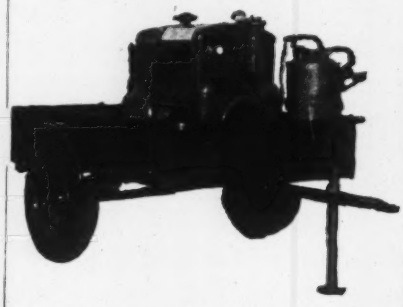
Air Trailer

Practical for many small tool operations such as road markers, paint spray, etc., the new Model 20 Schramm Trail-air



consists of a complete self-contained unit with electric self-starter and an air delivery of 20 cu.ft. per minute.

This unit, mounted on a trailer, can be coupled to a car or truck; it is so well balanced that it can be moved about by one man.—*Schramm, Inc., West Chester, Pa.*

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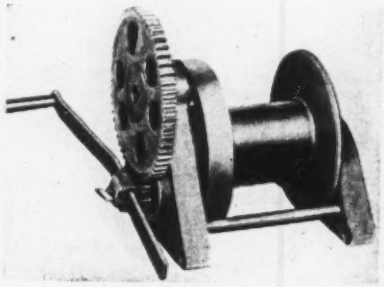
All Steel Winch

An all steel construction hand power unit, consisting of a drum mounted between two side frames rigidly held by two threaded shouldered tie bolts and a



stationary drum shaft, has been developed. The assembly is said to be capable, with a 70 lb. crank load, of handling 10,000 lb., with the drum accommodating up to ⅝ in. rope. All gears are held in place by a simple latch, making the shifting or removal of gears an easy task.—*American Hoist & Derrick Co., St. Paul 1, Minn.*

• • •

Material Handling Unit

More than two years have been spent in perfecting and testing the Model W4-5

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MISS.. Jackson—Mississippi Road Supply Co.
MO.... St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Noel V. Wood, Inc.
MONT.. Billings & Missoula—Industrial Equipment Co.
NEB.... Omaha—Nebraska Tractor & Equipment Company
North Platte—Cornhusker Tractor & Equip. Co.
NEV.... Reno—Brown Motors
N. H.... Manchester—R. C. Hazelton Co.
N. J.... Trenton—Ross, Young, Dilts Company
N. M.... Albuquerque—Hardin & Coggins
N. Y.... Buffalo—Dow & Company, .nc.
Brooklyn—Edward Ehrbar, Inc.
Long Island—George Malvese & Co.
Albany, Syracuse—Milton-Hale Mach. Co.
N. C.... Raleigh—J. B. Hunt & Sons
N. D.... Fargo—Myhra Equipment Company
OHIO... Cleveland—Gibson-Stewart Company
Cincinnati—Rish Equipment Co.
Cambridge—Major Equipment Co.
Marion—Hamilton Equipment Co.
OKLA.. Tulsa & Guthrie—C. L. Boyd Company, Inc.
ORE.... Portland & Eugene—Howard-Cooper Corporation
PA..... Butler—National Equ pment Co.
Pittsburgh—Atlas Equipment Corp.
Philadelphia—Service Supply Corp.
Harrisburg & Wilkes-Barre (Kingston)—
State Equipment Co.
R. I.... Providence—Tractors, Inc.
S. C.... Columbia—N. H. Summers Road Machinery Co.
S. D.... Sioux Falls, Rapid City—Empire Equipment Company
TENN.. Knoxville & Chattanooga—Brooks Equip. & Mfg. Co.
Nashville—Industrial Tractor & Equipment Co., Inc.
Memphis—Road Builders Equipment Co.
TEXAS.. Dallas & Houston—Browning-Ferris Machinery Co.
San Antonio—Jess McNeel Machinery Co.
Plainview & Sweetwater—Plains Mach. Co.
El Paso—Hardin and Coggins
UTAH.. Salt Lake City—The Lang Company
VA..... Richmond—Municipal Sales Company
Richmond and Roanoke—Rish Equipment Co.
Alexandria—Phillips Mach. & Tractor Co.
WASH.. Seattle—Howard-Cooper Corp.
Spokane—Intermountain Equip. Co.
W. VA.. Charleston and Clarksburg—Rish Equipment Co.
WIS.... Eau Claire—Bark River Culvert & Equipment Co.

SEE Adams
AD ON OPPOSITE PAGE

SMOOTH LANDINGS ASSURED WITH ADAMS GRADING THE JOB

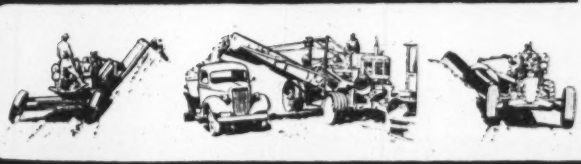
★ Pictured above is a typical airport construction job, with an Adams Motor Grader building the landing strips.

This particular job is on the Patton Brook Airport, Plainville, Conn., where three large landing strips are now under construction. With a main landing strip 600 ft. wide by 3000 ft. long, Patton Brook will be one of the largest privately-owned airports in New England when completed, capable of accomodating planes up to the Army's C-47.

In the course of the next seven years, thousands of airports are to be built or enlarged in this country, under the CAA national airport program. Obviously, this is going to mean a lot of extra business for alert contractors. Many of these contractors will choose Adams Motor Graders for their work . . . because they know that Adams have everything it takes for smooth, accurate, high-speed grading—the kind that pays off in faster, better jobs and higher profits.

Get the complete time-saving, money-saving facts from your local Adams dealer. You'll find there are no finer motor graders built—*at any price.*

J. D. ADAMS MANUFACTURING CO., INDIANAPOLIS, IND.



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ROAD BUILDING AND EARTH-MOVING EQUIPMENT

WHEN HOUSES ARE GOING UP

That's the time to look up your nearest AED Member.

He knows and will recommend the right machines for excavation, foundation, erection, grading and landscaping. You can depend upon

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Those who show the AED emblem represent reliable construction machinery organizations from coast to coast, in Canada and in Mexico.

AED Members maintain service shops with trained experts ready day or night, to keep machines going despite mishaps.

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ASSOCIATED EQUIPMENT DISTRIBUTORS
1928 EYE STREET, N.W.
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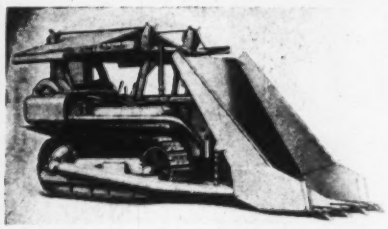
MobiLoader, for use with Caterpillar wide-gage D4 tractor. This unit has finger-tip hydraulic control and utilizes the overhead loading principle of straight-line production.

Design improvements are said to result in great visibility, and balanced mounting



on the tractor is said to give firm traction and minimum wear on idlers and rollers. Interchangeable buckets for various materials are available, and in addition an interchangeable bulldozer blade can be installed on the lift arms.—*Athey Products Corp., Chicago, Ill.*

• • •

Widening Finisher

Intended primarily for widening work on concrete paving construction, a single-screed type finisher can work on widths

from 2 to 6 ft. It has two traction speeds, forward and reverse, and two screed speeds to allow for concrete of different textures.

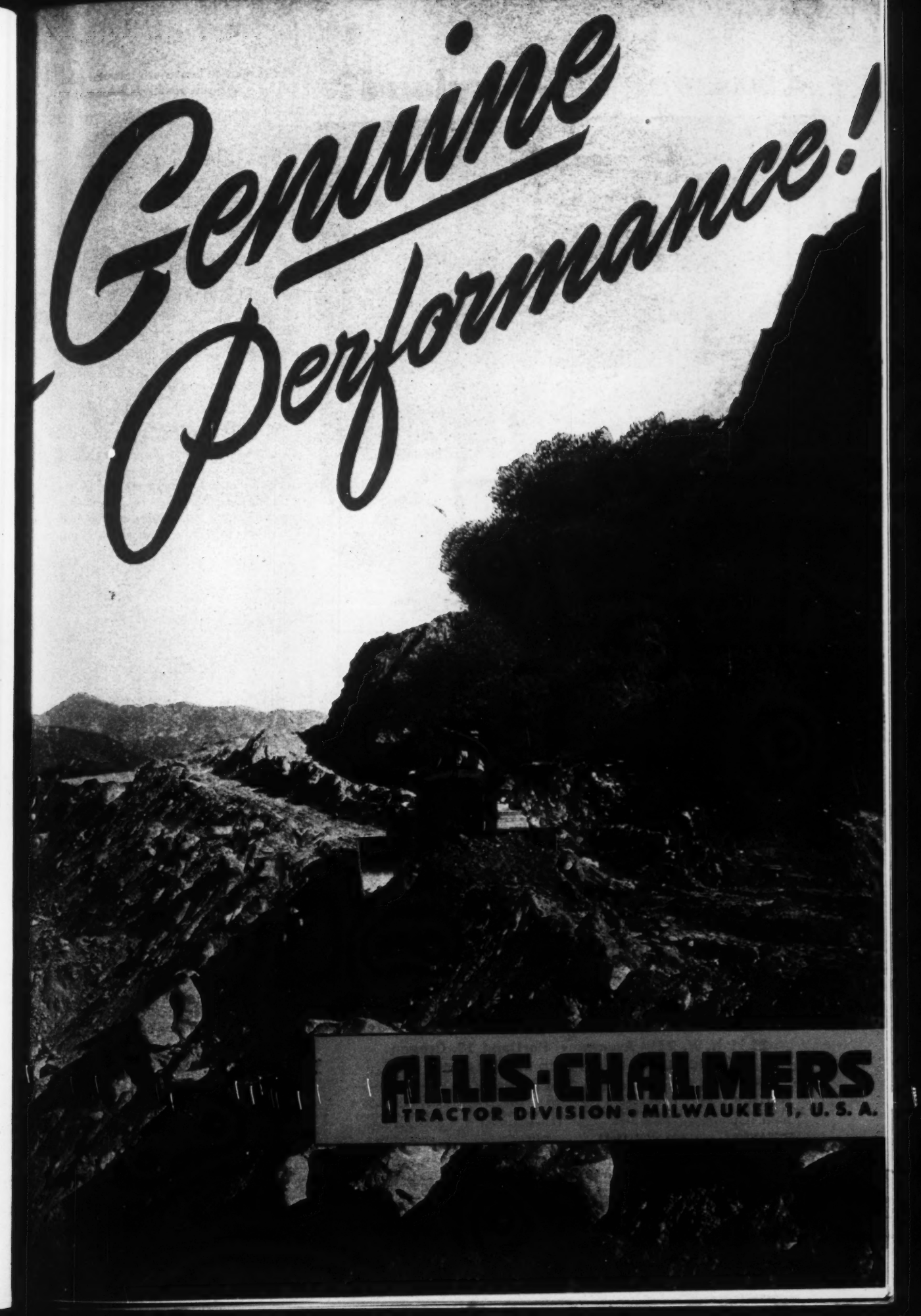
The same machine can be used for building concrete sidewalks.—*The Blaw-Knox Co., Pittsburgh, Pa.*

• • •

Nailing Channel

A speedy and permanent method of attaching tile, panels, insulation, etc., to steel, concrete and masonry, is offered in the new Nailock steel nailing channel, which provides an unusually wide nailing course. The channel, which may be attached in vertical, horizontal or inverted position, can be set in concrete or attached to steel members by clips, wiring or spot welding.

Special nails are provided, with variously shaped heads and rectangular, tap-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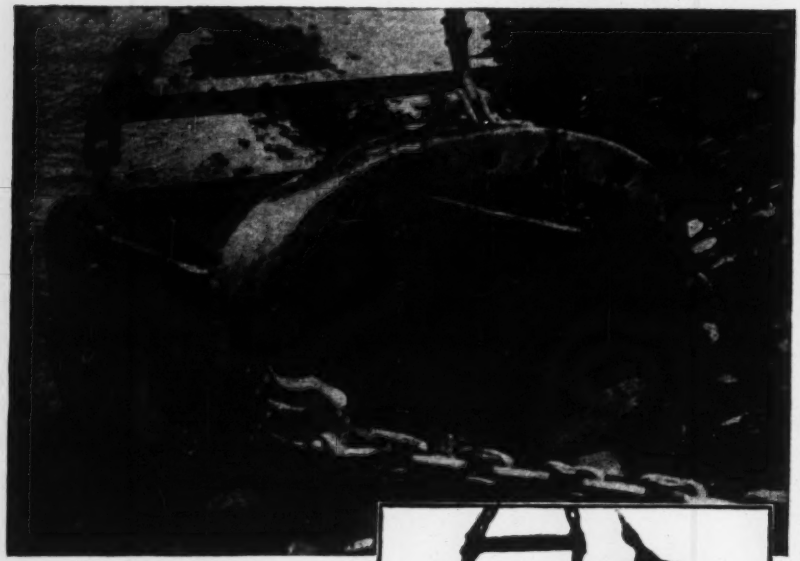
deadweight or payload?



ESCO 2½-yard standard bucket on operation of Central Mining Co., Alaska.

ESCO

Dragline Buckets
eliminate excess weight, carry greater payloads

To stand the gaff on hard jobs, a dragline bucket need not be excessively heavy.

ESCO buckets, the strongest per pound ever built, enable the operator to take bigger payloads, often using buckets of greater capacity than would be possible with other makes.

There are two main reasons for the oversize loads of *ESCO* buckets, and for the long, unfailing service they give:

1. *ESCO Manganese Steel* used for all parts subject to wear and shock, including rigging. Manganese steel castings get harder and tougher the more they work, need not be cast excessively heavy in order to allow for wear. Manganese steel castings polish in use, lessen friction, resist abrasion.
2. Engineered for efficient digging. *ESCO* buckets are designed by top notch engineers who also are practical construction men. Streamlined tooth horns are cast integrally into the cutting lip — no bulky tooth holders to offer resistance.

Buckets for Special Purposes

ESCO dragline buckets are available in three types — standard, medium and heavy duty. In addition, *ESCO* designs and builds special buckets for unusual operations. Consultation is invited on special excavating problems. See your nearest *ESCO* representative or write direct. Catalogs of dragline and dipper buckets on request.

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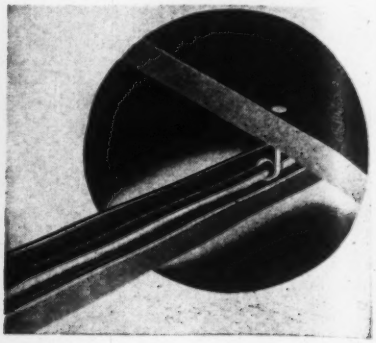
SPOKANE, 8 121 S. Monroe St. Main 5530	LOS ANGELES, 11 4600 Pacific Blvd. Lucas 7251	CHICAGO, 1 221 N. LaSalle St. Dearborn 2284	EUGENE, ORE. 1991 Sixth Ave., W. Phone 5012

IN CANADA— *ESCO* LIMITED, 1084 Homer St., Vancouver, B. C. Telephone Marine 2343

ered shanks. When driven into the channel the nail bends readily, hooking itself



automatically around the rod.—*Sanymetal Products Co., Inc., 1677 Urban Road, Cleveland 12, Ohio.*

• • •

New Drafting Pencil

Light in weight and properly balanced, a new refillable draftsman's pencil is especially designed for engineers and draftsmen. Its long barrel permits the use of any full-length standard drafting lead. The properly tapered point and well pro-

portioned grip merge smoothly with the lead, offering, especially when lettering, greater finger comfort. A new type of clutch holds the lead firmly in a non-slip rubber grip that prevents the usual nicking and scoring of lead which cause breakage.—*Charles Bruning Co., 4654-8 Montrose Ave., Chicago 41, Ill.*

• • •

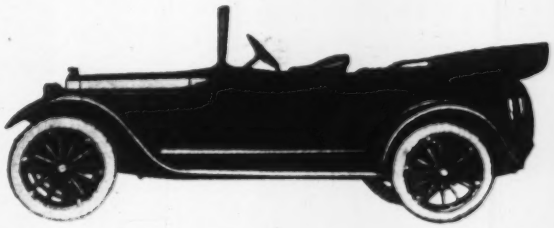
Tracing Reproducer

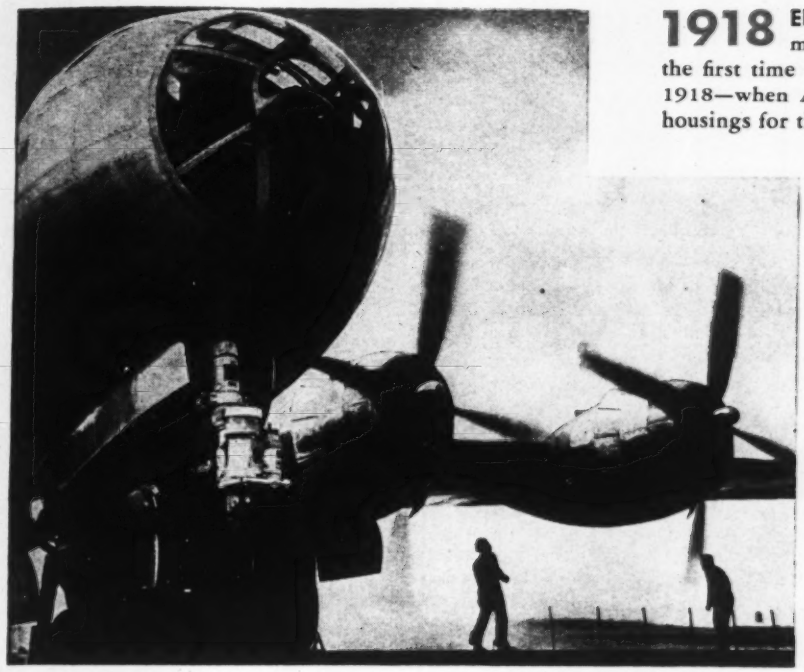
High quality whiteprints (dry direct process) are economically produced in cut sheets or rolls, in one continuous operation, at 30 ft. per minute, by the Pease "88-R" printing and developing machine, it is asserted. Requiring minimum operator attention, tracings and sensitized papers are fed in; virtually everything else is automatic and the finished prints are delivered in a matter of seconds.

An outstanding feature of this printer is the optional use of revolving or sliding contact. Other advantages: contact cyl-

1918 Motor Cars and 1946 Planes

WELDING MADE THEM POSSIBLE





1918 **Electric arc welding,** as a practical mass-production tool, was used for the first time in the building of automobiles in 1918—when A. O. Smith welded the rear axle housings for the 1919 Chalmers motor car.

1946

Today, A. O. Smith research developments make welding the modern production tool for all transportation —automotive, rail, ship, plane. Every B-29, for example, lands on SMITHway-welded landing gear.

THE PROOF IS IN PRODUCTION

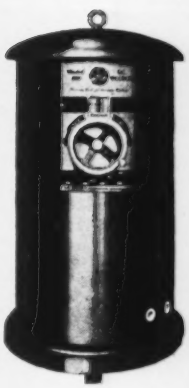
America's tremendous industrial production—in peace and war—could not be achieved without the modern production tool, welding.

More than 7 million tons of steel products have been welded by A. O. Smith, whose plants have used as many as 320,000 SMITHway Electrodes *daily.* Millions more are used by fabricators and builders everywhere.

Each one is the proved result of A. O. Smith welding research, a search for improvement that never ends.

SMITHway A. C. Welders

A complete line of six models—150-, 200-, 250-ampere capacity; and for heavy-duty service, 300-, 400-, and 500-ampere capacity. Write for complete specifications and prices.



made by welders . . . for welders *Mild Steel . . . High Tensile . . . Stainless Steel . . . Welding Electrodes*

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inder cooled by same blower which forms the vacuum to convey exposed prints to the ammonia fume developer; foot treadle

which allows tracings and paper to be withdrawn without damage; thoroughly confined ammonia fumes controlled by a selective ammonia feed.—*The C. F. Pease Co., Chicago, Ill.*

• • •

Automatic Surface Sprayer

There is no guesswork with the Flex-Plane spraying machine, the manufacturer states, because this automatic device sprays each square foot of surface evenly, completing its work before drying and hair cracking can develop. The sprayer is adjustable for single-lane (10 to 12½ ft.) and two-lane (20 to 25 ft.) construction.

Curing material can be sprayed as soon as the surface is finished, thus holding moisture. The sprayer is propelled by a gasoline engine which also delivers the material under pressure to the nozzle.—*Flexible Road Joint Machine Co., Warren, Ohio.*

• • •

Carbide-Tipped Drill Bit

Tipped with carbide, the Cyclone drill-bit is said to drill holes 50 percent faster in masonry materials and to last considerably longer than other high-speed bits. As carbide does not lose its cutting edge when running absolutely hot, a bit tipped with this metal is fast and accurate in drilling concrete, brick tile, marble, etc.

This drill is available in stock sizes from ⅜ in. to 1½ in. dia., by sixteenths.—*New England Carbide Tool Co., 60 Brookline St., Cambridge, Mass.*

• • •

Concrete Mixer

High-strength steel is used at all points of wear on the 11-S Kwik-Mix Dandie concrete mixer. This unit has a tilted flow-line discharge chute, selective skip shaker and remixing drum. The mixer has a rated capacity of 11 cu.ft. of mixed concrete, plus 10 percent; it complies with AGC specifications.

Model 11-S is furnished either on four wheels with side or end discharge, or on two wheels with end discharge.—*Kwik-Mix Co., Port Washington, Wis.*

• • •

Highway Truck

Now in mass production, a 4-ton FWD Model HG all-purpose highway construction and maintenance truck is designed to mount such optional equipment as body, hoist, underbody blade and snow plow fittings. It has a clearance of 22½ to 24$\frac{13}{32}$ in., depending on tire size, and is

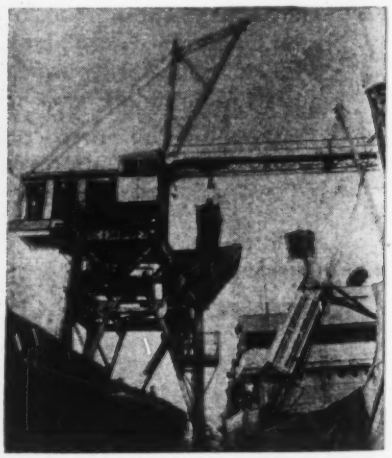
made to grade roads at 5 to 15 mph. and maintain roads up to 20 mph.

Model HG has strong 5-speed transmission; power transmitted to front and rear drive shaft through a shock-absorbing chain drive and fully compensating center differential; axles with full-floating axle shafts; interchangeable ring gears and pinions. The 6-cylinder engine develops 98 bhp. and has a torque of 270 lb.—*Four Wheel Auto Drive Co., Clintonville, Wis.*

• • •

Rapid Material Handler

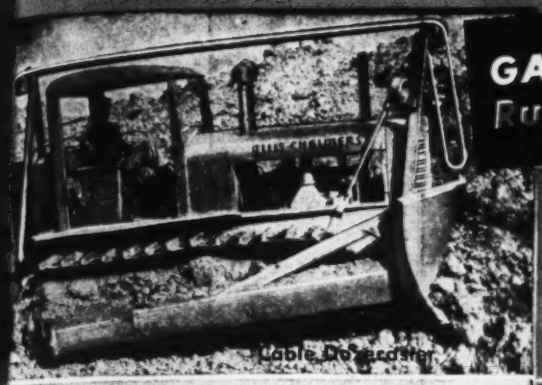
A horizontal boom, full revolving crane, shown here unloading coal, is said



to be adaptable to construction uses such as placing concrete. It would have the

Down-to-Earth Engineering

GAR WOOD Cable Controls Feature Rugged Simplicity and Direct Action Pull



Cable Dozercaster

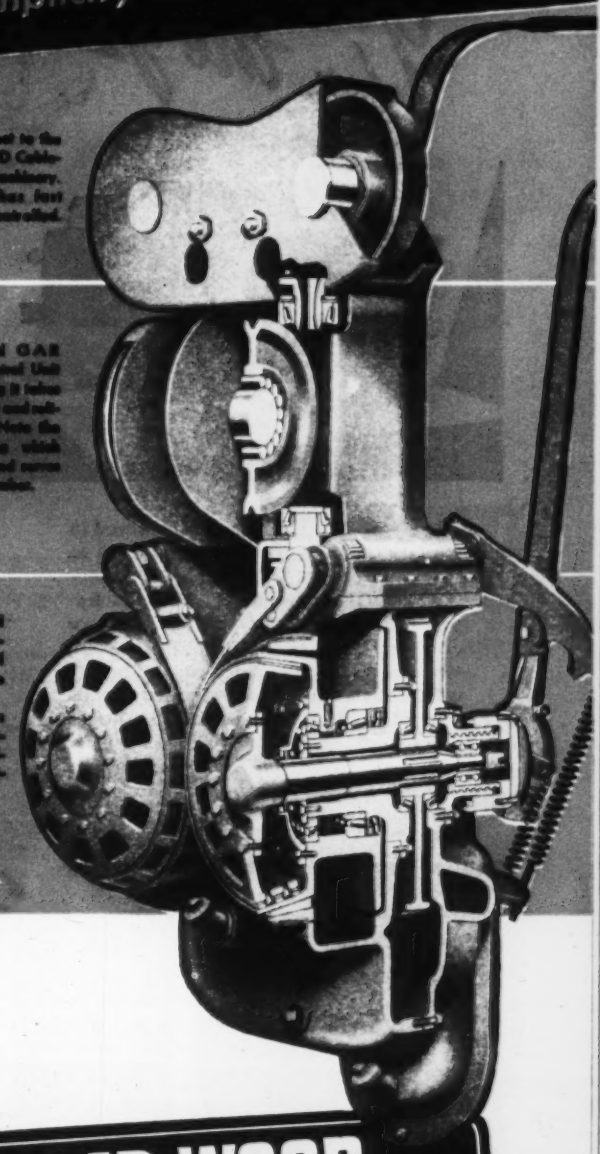
Heavy-Duty Cable Ripper

Cable Scraper

The cable goes direct to the job in GAR WOOD Cable-Controlled Road Machinery. As a result, it has fast action, positively controlled.

The Job-proved GAR WOOD Cable Control Unit (right) has everything it takes for smooth operation and reliable performance. Note the sturdy steel housing which prevents distortion and serves as a lubrication chamber.

Outside clutches and servo-type, self-energizing brakes used themselves and are readily accessible. Roller bearings throughout and worm-type gears have adjustments at a minimum.



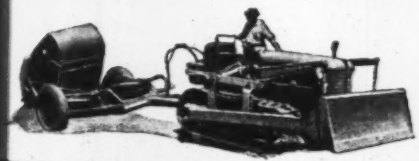
PROVED through the years on the toughest of jobs. Made more rugged than ever by the lessons learned in war action on every front, from Guadalcanal to Okinawa and from Oran to Berlin.

GAR WOOD Road Machinery and the famous GAR WOOD Cable Control Power Unit offers practical design and sound construction, well engineered and honestly built—equipment that *holds together* and can be operated with an absolute minimum of down time. *If it's* GAR WOOD, *it's good.*

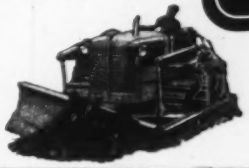
See your Allis-Chalmers dealer. He'll be happy to give you all the facts and show you Gar Wood Earth Moving Equipment *on the job* in your own vicinity.

GAR WOOD ROAD MACHINERY

WITH ALLIS-CHALMERS DIESEL POWER



Gar Wood 2-Wheel Hydraulic Scraper and Bulldozer



Gar Wood Hydraulic Dozecaster

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Varied ratio combinations are offered in Fuller heavy duty truck transmissions so that you can take full advantage of every factor in the power train. This is important to balanced truck performance ... to low-cost operation. For this reason, whether your job calls for rugged power off the highway ... or sustained speeds over the highway ... you can let the *job* specify the *transmission* when *you* specify Fuller *geared to the job* transmissions. They are quiet running, easy to maintain, easy to shift.

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Write today for full information and prices on the White Type II Transit.
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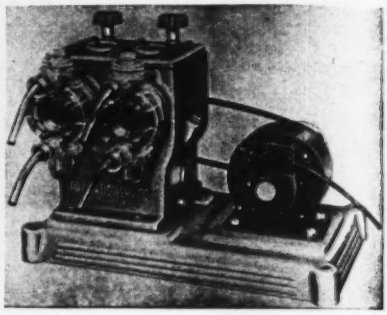
Manufacturers of Instruments for Engineers, Surveyors and Builders.

advantage of more rapid and accurate "spotting" of the bucket and while not intended for rapid rotation could reach all parts of a form from one position. The crane is said to have many of the advantages of the hammerhead rig, to be lower in first cost and more versatile.—*Clyde Iron Works, Inc., Box 370. Duluth 1, Minn.*

• • •

Chemical Proportioning Pump

Chemical reagents are delivered in an almost continuous stream, it is claimed, with the new diaphragm-type Duplex Deluxe Chem-O-Feeder. Designed for positive injection of one or two chemicals at predetermined and adjustable rates, the



pump has many uses, including water sterilization.

Vital operating parts may be observed through transparent plastic reagent heads, and each discharge stroke of the feeder is visible in sight feeder domes. Moving parts operate in an oil bath.—*Proportioneers, Inc., 92 Codding St., Providence, R. I.*

• • •

Concrete Floors

New information on how to build concrete floors and resurface old ones is available, including hitherto unpublished data on value of use of high-early strength cement with short periods of moist curing. Specification and step-by-step procedures for making good concrete floors, well illustrated by good how-to-do-it pictures, are of considerable value to engineers, contractors and maintenance men.—*Lone Star Cement Corp., 342 Madison Ave., New York 17, N. Y.*

• • •

Spreader Pot

A new pot to spread tar, asphalt, sand, gravel, slag, salt, etc., has a big shovel opening for easy filling and a comfortable carrying handle. The adjustable opening, combined with the big back handle, is said to provide perfect "flow control" in pouring solids. This pot, 10 in. dia. and 15 in. high, has a 4½ gal. capacity, or ½ cu.ft. of dry materials; its shipping weight is 7 lb.—*Aeroil Products Co., Park and 57th, West New York, N. J.*

New Engineering Books

(*Continued from page* 112)

LEGAL PHASES OF CONSTRUCTION CONTRACTS—By I. Vernon Werbin. 267 pp. McGraw-Hill Book Co., New York 18, $2.75.

WATER TREATMENT AND PURIFICATION—Second edition—By William J. Ryan. 270 pp. McGraw-Hill Book Co., New York 18, $2.75.

ECONOMIC STAGNATION OR PROGRESS—By Ernst W. Swanson and Emerson P. Schmidt. 212 pp. McGraw-Hill Book Co., New York 18, and London. $2.50.

DEVELOPMENT OF MATHEMATICS—Second Edition—By E. T. Bell. 637 pp. McGraw-Hill Book Co., New York 18, and London. $5.

BITUMINOUS PAVEMENTS—Section G of Standard Specifications for Public Works Construction: G1, Sheet Asphalt ($1); G2, Bituminous Macadam ($1); G3, Asphaltic Concrete ($1); G4, Cold Laid Asphaltic Concrete ($1). American Public Works Association, 1313 East 60th St. Chicago 37, Ill. $4.

Reports and Pamphlets

PUBLICATIONS AVAILABLE FOR DISTRIBUTION—List No. 1. U. S. Waterways Experiment Station, Vicksburg, Miss.

THE IOWA INSTITUTE OF HYDRAULIC RESEARCH—Bulletin No. 30. Published by the State University of Iowa, Iowa City, Iowa.

A REPORT ON A TYPHOID FEVER EPIDEMIC AT MANTENO STATE HOSPITAL IN 1939—prepared largely from the unpublished reports and findings of Carl E. Schwob and C. Milton Eberhart, Department of Public Health, Springfield, Ill.

REPORT ON REGIONAL CONFERENCE ON TOPOGRAPHIC MAPPING—American Congress on Surveying and Mapping held in Washington, D. C. June 21, 1945. P.O. Box 470, Washington 4, D. C.

BUILDING CODE MODERNIZATION—American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N. Y.

RECOMMENDED PRACTICE OF STREET AND HIGHWAY LIGHTING-1945 — Illuminating Engineering Society, 51 Madison Ave., New York 10, N. Y. 50c.

NEW AND ACCELERATED METHODS APPLIED TO ENGINEERING PROCEDURES—By Louis H. Berger. C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.

A REVIEW OF RAILWAY OPERATIONS IN 1945—Bureau of Railway Economics, Association of American Railroads, Transportation Building, Washington 6, D. C.

TIRE WEAR AND COST ON SELECTED ROADWAY SURFACES—R. A. Moyer and Glen L. Tesdall. Iowa Engineering Experiment Station Bulletin 161. Iowa State College Bulletin, Ames, Iowa.

POLICY AND PROGRAM—Interstate Commission on the Potomac River Basin, 520 Transportation Building, Washington 6, D. C.

22 Adjustable Lateral Braces and Anchor Stakes for use on rigid or flexible radius forms hold top of form in positive alignment.

26 No loose parts or clamps. Secure the face form to the division plate, slide the locks home and start to pour.

27 Face forms are quickly removed after the concrete has taken its initial set, by disengaging the lock. Skeleton division plates are provided with the same arrangement.

29 A sleeve welded on one end of the rail over which the adjoining rail fits, makes an absolutely tight even joint.

31 Round stakes securely locked to the form by the wedge key permit the form to be suspended entirely independent of the subgrade. Indispensable when subgrade conditions are not uniform.

You buy Heltzel Steel Forms once. They stay in service for 20 years or more and each job you set is as uniform as the ones before. The low cost of equipment per year of service plus benefits of faster work with the use of steel forms, nets substantial savings and more business.

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BUILDS IT BETTER

BINS, Portable and Stationary
CEMENT BINS, Portable and Stationary
CENTRAL MIXING PLANTS
BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
BITUMINOUS PAVING FORMS
ROAD FORMS (with lip curb and integral curb attachments)
CURB FORMS
CURB AND GUTTER FORMS
SIDEWALK FORMS
SEWER AND TUNNEL FORMS
CONCRETE BUCKETS
SUBGRADE TESTERS
SUBGRADE PLANERS
TOOL BOXES
FINISHING TOOLS FOR CONCRETE ROADS

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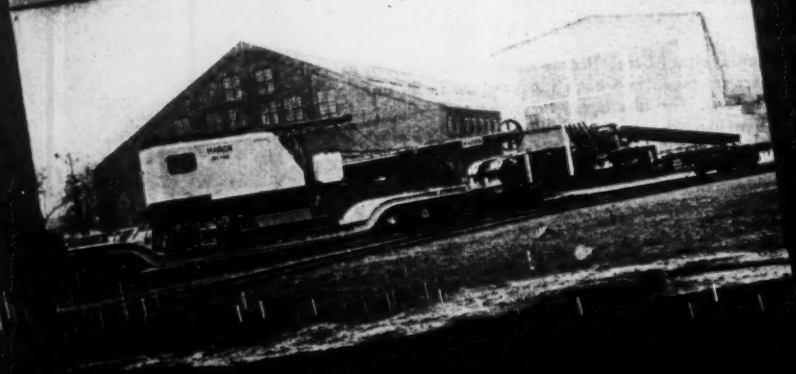
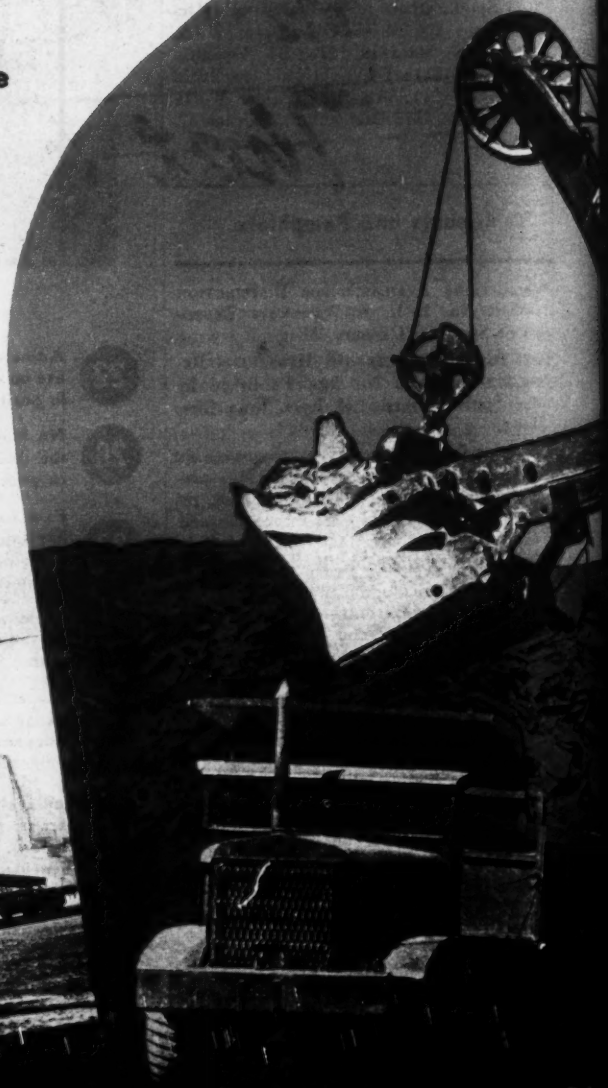
Here is a modern, heavy duty Diesel machine that is a top yardage producer in mining, quarrying, and heavy construction. It has the power—speed—and rugged strength to out-perform anything in its class under all digging conditions. It is a REAL MARION through and through. The MARION 111-M is easily and quickly convertible to dragline service. It ships without major dismantling. Let us tell you more about this outstanding performer.





FROM 3 4 CU YD
POWER SHOVEL COMPANY
MARION
SINCE 1884
TO 40 CU YDS

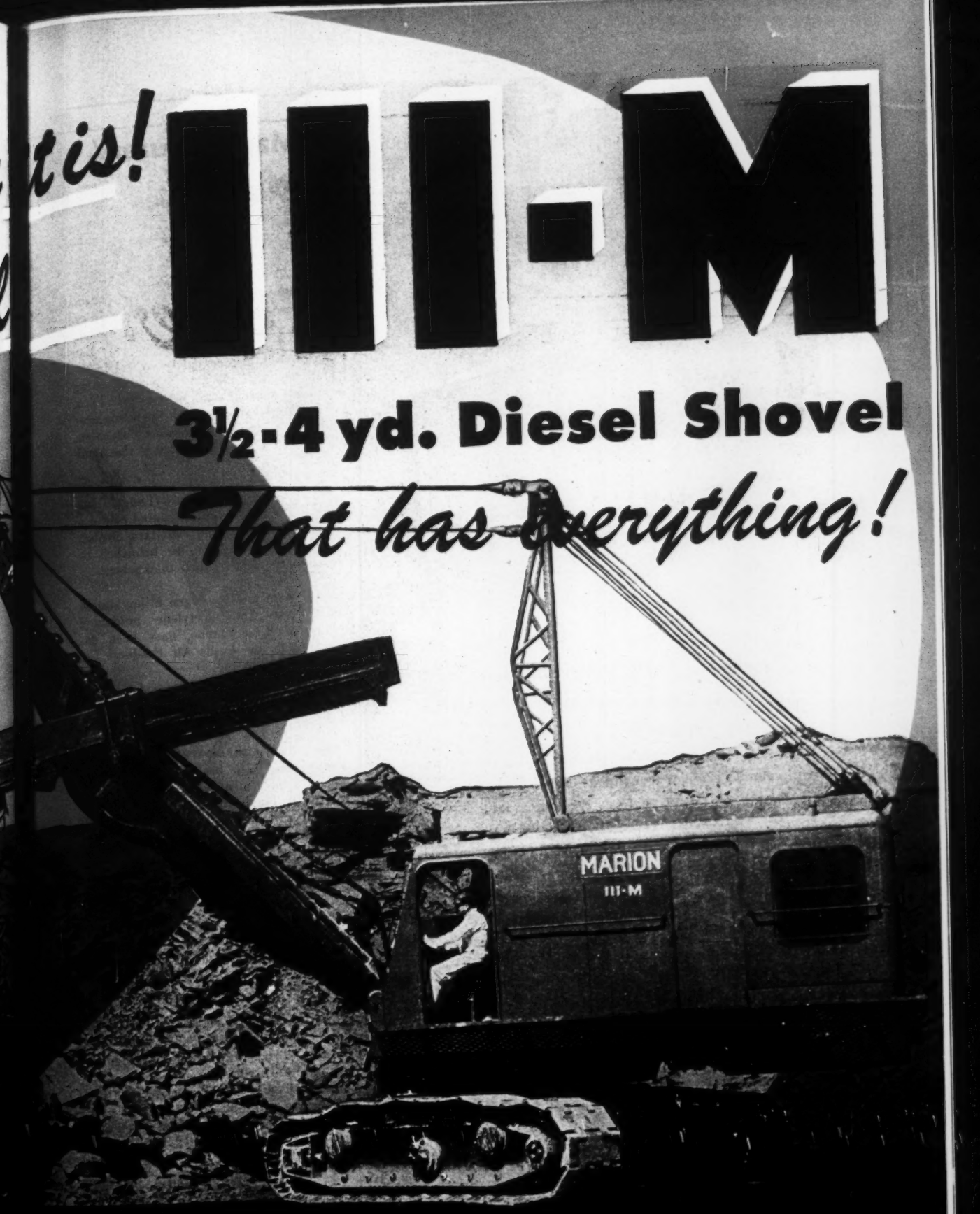
MARION

t is!

111-M

3½-4 yd. Diesel Shovel

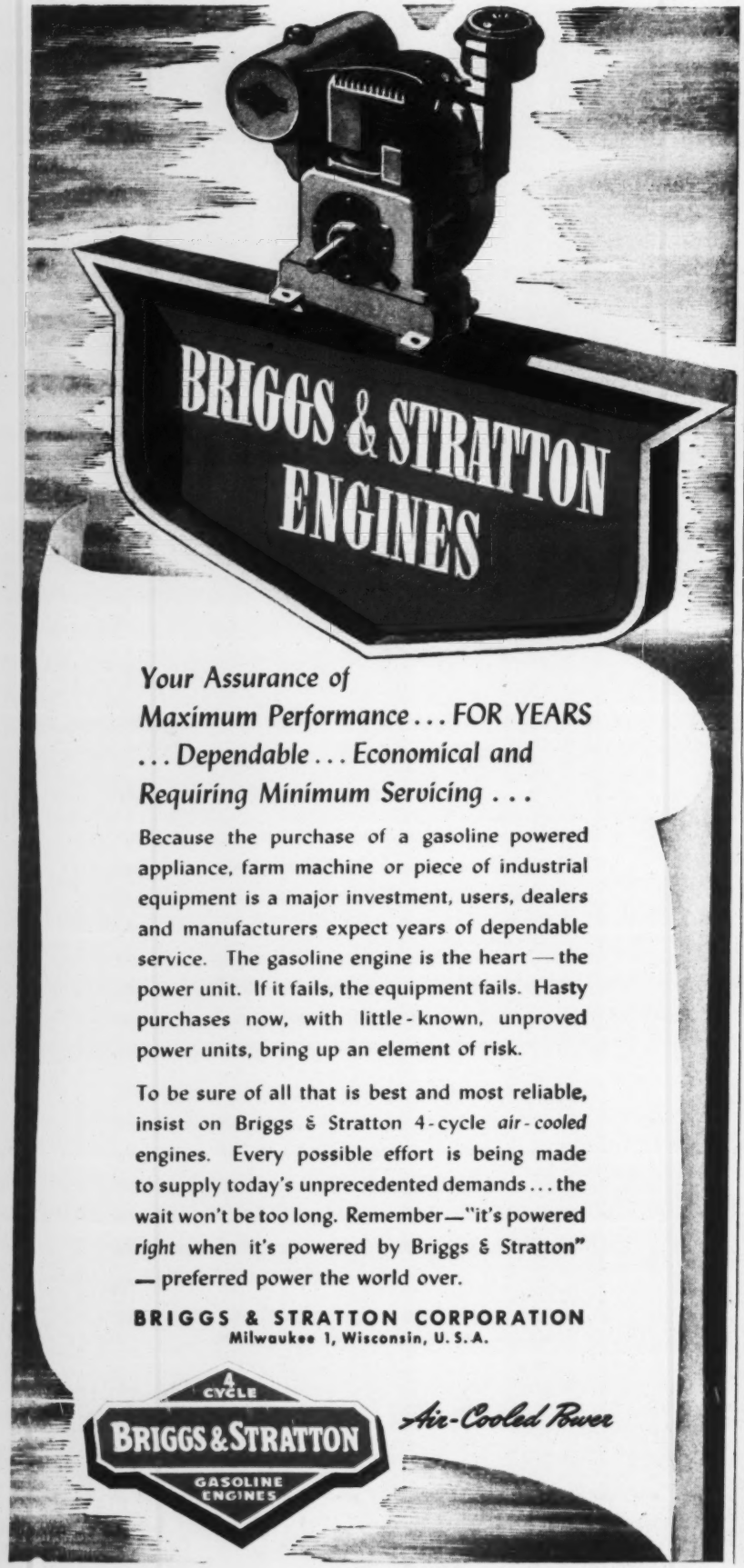
That has everything!



POWER SHOVEL COMPANY

Marion, Ohio, U.S.A.

Offices and Warehouses in all Principal Cities


BRIGGS & STRATTON
ENGINES
Your Assurance of
Maximum Performance... FOR YEARS
... Dependable... Economical and
Requiring Minimum Servicing...
Because the purchase of a gasoline powered appliance, farm machine or piece of industrial equipment is a major investment, users, dealers and manufacturers expect years of dependable service. The gasoline engine is the heart — the power unit. If it fails, the equipment fails. Hasty purchases now, with little-known, unproved power units, bring up an element of risk.
To be sure of all that is best and most reliable, insist on Briggs & Stratton 4-cycle air-cooled engines. Every possible effort is being made to supply today's unprecedented demands... the wait won't be too long. Remember—"it's powered right when it's powered by Briggs & Stratton" — preferred power the world over.
BRIGGS & STRATTON CORPORATION
Milwaukee 1, Wisconsin, U. S. A.
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES
Air-Cooled Power

Manufacturers' Activities

COL. B. O. HENDERSON, a civil engineer graduate of the University of Wisconsin, has become sales manager of Miller, Bradford & Risberg Co., distributors of road construction equipment at Eau Claire, Wis. He served two years in the first world war and later was a consulting engineer and general contractor. From 1921 to 1941, assistant division engineer for the Wisconsin Highway Commission, he was called to active duty in the Army in 1941.

THE KORFUND CO., INC., Long Island City, N. Y., has been appointed sole distributor of Armstrong Standard Density Vibracork, which is to be furnished by Korfund in 2- to 4-inch thicknesses.

PLANS for a new oxygen filling station and Prest-O-Lite acetylene producing plant, in Boise, Idaho, have been announced by the Linde Air Products Co.

LA PLANTE-CHOATE MFG. CO., INC. of Cedar Rapids, Iowa, has established a factory branch at Oakland, Calif.

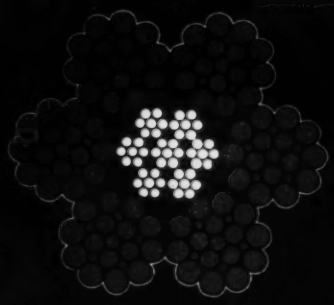
THE SMITH ENGINEERING WORKS of Milwaukee, Wis., has made these new agency appointments: Martin Machinery Co., 4534 Travis Street, Dallas 5, Tex., for all of Northern Texas; Smith Commercial Body Works of Fargo, N. D., for North Dakota; and J. D. Evans Equipment Co. of Rapid City, S. D., for South Dakota.

LT. COL. A. E. FERGUSON, has resumed as western sales manager of the American Lumber and Treating Co. in the Chamber of Commerce Building, Los Angeles, Calif.

THE PATTEN TRACTOR & EQUIPMENT Co. has opened a new plant in Bellwood, Ill., near Chicago. Functionally designed to facilitate distribution and servicing of Caterpillar and allied products, the plant's two buildings occupy only one third of a 3½ acre plot, leaving ample space for parking and yard use. Caterpillar, Athey, Hyster, Trackson, J. I. Case and Union Wire Rope products are handled.

PARKER M. ROBINSON is San Francisco district manager for the Pittsburgh Testing Laboratory, Pittsburgh, Pa., following the recent purchase of Smith, Emery & Co., technical material-testing labora-

Resists Abuse Better...



UPSON-WALTON IWRC* WIRE ROPE

FOR winch lines on trucks and tractors . . . for hoist lines on power shovels and in-haul ropes on draglines . . . for hot ladle cranes in steel mills and foundries . . . for cable scrapers, stump pulling ropes, rotary drilling lines for oil wells, mining machines—industry after industry operates under conditions which require IWRC (*Independent Wire Rope Center) construction to do the best job.

IWRC construction resists crushing better where ropes crosswind on drums, retains its circular cross section when bent around small sheaves and drums under extra heavy loads. It resists stretching, resists heat and increases the ultimate strength of the rope itself.

IWRC construction is available in every type of wire rope made by Upson-Walton.

For best performance, select the U-W rope best suited to your needs and specify *IWRC, Perfection Grade, Layrite Preformed.*

U-W

Established 1871

All Upson-Walton Products Available Through Your Local Upson-Walton Distributor

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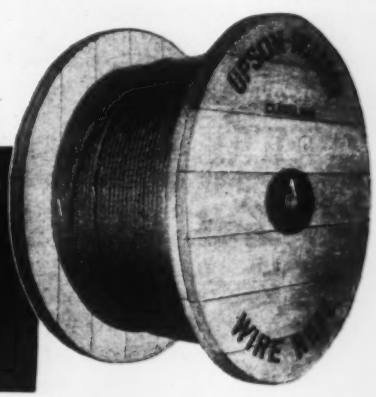


THE UPSON-WALTON COMPANY

Manufacturers of Wire Rope, Wire Rope Fittings, Tackle Blocks

MAIN OFFICES AND FACTORY: CLEVELAND 13, OHIO

114 Broad Street, New York 4 | 737 W. Van Buren Street, Chicago 7 | 241 Oliver Building, Pittsburgh 22

UNIFORMITY

SENSITIVE fingers rejoice in discovering in MICROTOMIC "VAN DYKE" the absoluteness of uniformity in grading on which a draftsman depends for true pencil satisfaction. We suggest that you become sufficiently aroused to visit our accredited "VAN DYKE" Dealer for your favored degrees.

tory of San Francisco. This office will serve northern California and Nevada, and Oregon, Washington and Idaho in an inspection capacity for large industrial plants and as laboratory tester of basic materials and methods of fabrication.

FRED M. VILES of Viles Machinery Co., distributors of heavy construction equipment in the Spokane, Wash. area, has recently been appointed director of region 12 of the Associated Equipment Distributors for Washington, Oregon, Idaho, Montana and Alaska.

JAMES P. STEWART has been appointed special representative of the De Laval Steam Turbine Co., Trenton, N. J., for centrifugal blowers and compressors.

W. F. ROCKWELL has been elected to the board of directors of the United Engineering and Foundry Co., Pittsburgh, Pa.

PIONEER ENGINEERING WORKS, Minneapolis, Minn., has announced the consolidation of all its service activities under Harold E. Rollin, manager of sales engineering.

W. K. PERKINS has been appointed manager of sales for the International Harvester Co.'s motor truck division; J. T. Sullivan central district sales manager, succeeding W. A. Riggs, transferred to the northwest district, who in turn replaces R. R. McDonald, who goes to the new branch at Salt Lake City.

THE MILTON HALE MACHINERY CO., INC., of 438 E. Brighton Ave., Syracuse, N. Y., has been appointed distributor for Wickwire Spencer wire rope in Syracuse and Albany.

DON SMITH, formerly sales manager of the General Excavator Co., Marion, Ohio, is now vice-president and director of sales for the Milwaukee Hydraulic Corp., Milwaukee, Wis. He has been in the excavator industry for 20 years.

LEVINSON STEEL SALES CO., 33 Pride Street, Pittsburgh 19, Pa., has been appointed distributor and sales agent for Thorn steel windows and steel doors.

HARRY F. VAN WAGNER, formerly assistant sales manager for the Universal Atlas Cement Co., has been appointed assistant sales manager of the Glens Falls Portland Cement Co., Glens Falls, N. Y.

CHARLES M. WHALEN has joined the staff of the Griffin Wellpoint Corp., New York City, as sales representative. Mr. Whalen has been in the construction field for a number of years and, until recently, was with the sales department of Universal Atlas Cement Co. in the New England and metropolitan New York areas.

THE PROPERTY of the Indiana Cotton Mills at Cannelton, Ind., has been sold to interests representing the Bemis Bro. Bag Co. A new company is being organized to operate the plant.

DAN K. HEIPLE, a 1941 engineering graduate of Purdue University, has returned from the Navy to R. G. Le Tourneau, Inc., of Peoria, Ill., as field engineer in the installation department.

FOOTE BROS. GEAR AND MACHINE CORP., Chicago, has appointed Irving C. Maust to the West Coast sales engineering staff at Pasadena, Calif. He is a graduate of the University of Nebraska.

JOHN P. STENNER has been appointed to the sales organization of the A. P. Smith Manufacturing Co., East Orange, N. J., manufacturers of waterworks equipment.

E. S. GRAYBILL has been appointed manager of the acoustical department of the building materials division of the Armstrong Cork Co., succeeding V. B. Despard, Jr., resigned.

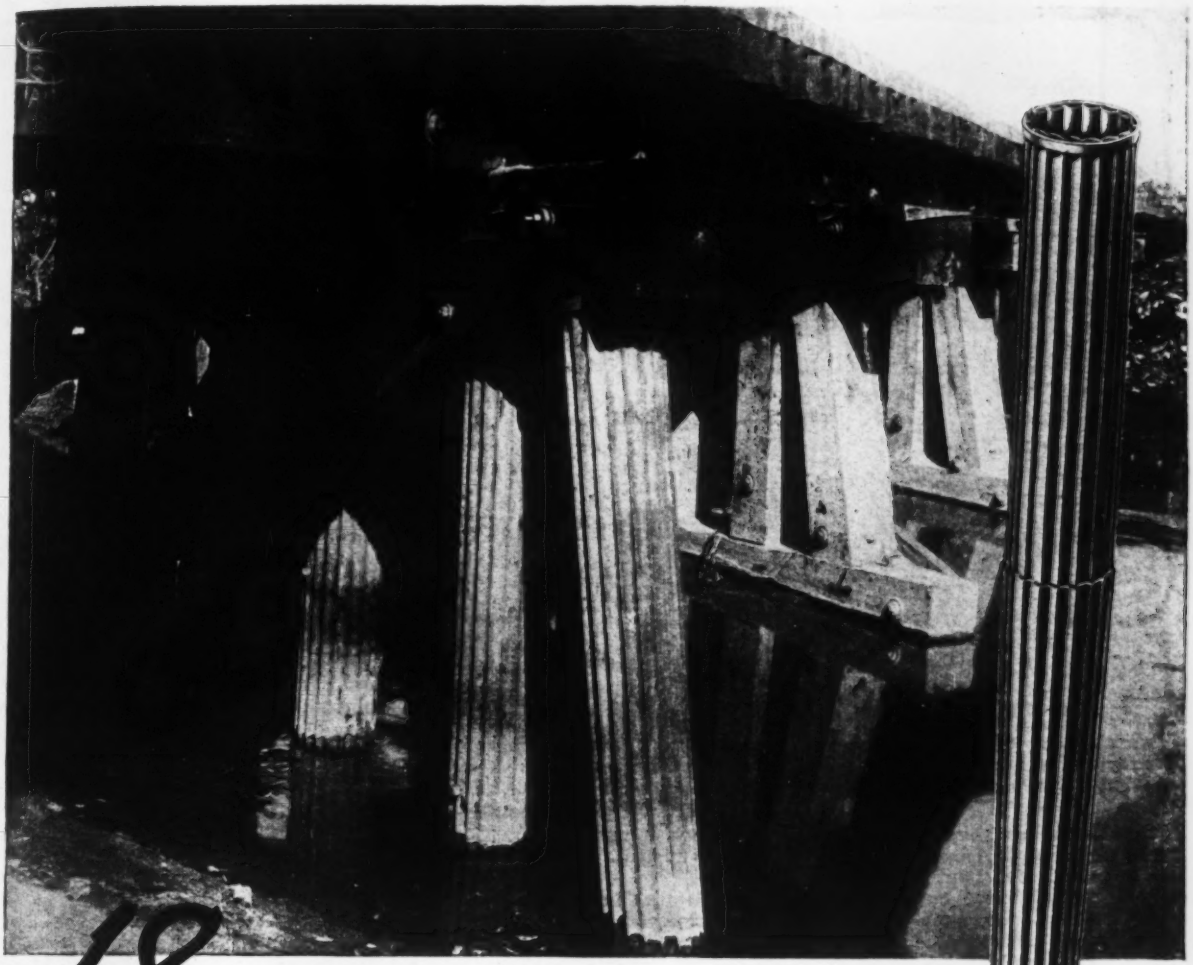
CHARLES A. MAYER has been appointed assistant engineer in the New York City office of The Asphalt Institute.

LIMA LOCOMOTIVE WORKS, INC., shovel and crane division, Lima, Ohio, announces the appointment of the Foulger Equipment Co., Salt Lake City, Utah, as sales agent in Utah and southwestern Wyoming. Bert Foulger, originator of the company, had been employed by the Utah Construction Co. for 27 years.

LUTHER LEWIS, who has been executive vice president of the Chicago Pneumatic Tool Co. since 1931, has been elected to succeed H. A. Jackson as president. The latter is chairman of the board of directors having relinquished the position of president, at his own request.

RUDOLPH LOUIS SUHL, 63, manager of the nickel sales department of the International Nickel Co. at New York, and an outstanding personality in the nickel industry and one of its pioneers, died June 10, at Plainfield, N. J.

EUGENE H. HEALD, who began work as a draftsman for American Bridge Co. 44 years ago, retired on July 1 as vice president in charge of sales and a director of this United States Steel subsidiary. He was succeeded by Norman B. Obbard, who during the war managed the company's Ambridge, Pa., shipyard, supervising the building of 143 Navy combat ships.



18 years of Service...and Still Going strong! MONOTUBE Foundation Piles

IN 1928 the first tapered steel Monotube foundation piles were installed on one complete bent of a Wheeling and Lake Erie Railroad trestle bridge. Last month Union Metal engineers made a thorough inspection of that first Monotube piling job. They found it in excellent condition—*ready to serve for years to come*—and brought in the un-retouched photo at the top of this page to prove their point.

Today, job-wise engineers and contractors are using thousands of Monotubes for the construction of bridges, highways, underpasses and buildings.

Monotubes are light in weight, easy to handle, simple to install. They can be driven with average job equipment . . . extended easily on the job. They permit quick, thorough inspection because of their hollow, tubular construction.

For friendly cooperation, call on our engineers to help you with your planning. They'll show you why Monotube's low cost, easy handling and integrity make them preferred in foundation construction. Union Metal Manufacturing Co., Canton 5, Ohio.

UNION METAL

Monotube Foundation Piles

THERE'S plenty of food here for wood-destroying fungi and termites to feast on—but they're doomed to die if they try.

Such wood as this, treated with "CZC," is protected from decay and termite attack. Du Pont "CZC" Chromated Zinc Chloride resists the development of fungous growths. In addition, "CZC"-treated wood is resistant to fire, has no objectionable odor, is clean and easy to handle, and can be painted. "CZC"-treated wood has all the characteristics of untreated wood, plus these other advantages.

Give your structures additional long life and assurance of low maintenance costs by specifying "CZC"-treated wood.

For detailed information about this wood preservative that makes wood last longer, write E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Wilmington 98, Del.

DU PONT CZC

Chromated Zinc Chloride

MAKES WOOD RESIST DECAY · REPEL TERMITES · RETARD FIRE

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

TRACK HAULAGE IS CHEAPER HAULAGE

PLYMOUTH LOCOMOTIVES

• FROM 2½ TO 70 TONS •

PLYMOUTH LOCOMOTIVE WORKS

Division of The Fate-Root-Heath Co. PLYMOUTH, OHIO, U. S. A.

Manufacturers' Publications

Proportioning Pumps—A bulletin illustrates and describes a new proportioning pump for precision, continuous blending of fluids in the chemical treatment of water.—*Lapp Insulator Co., Inc., Le Roy, N. Y.*

Protective Coating—An illustrated booklet tells the complete story about a coating to protect against acids, alkalis, oil and water. It also has case histories and full directions for use on concrete, structural steel, floors, pipes, tanks, machinery and other equipment.—*Prufcoat Laboratories, Inc., 63 Main Street, Cambridge 42, Mass.*

Automotive Traction Device—A manual describes a new device that is interchangeable with the conventional differential assembly tested in the prewar civilian market, during the war where it was used in all U. S. Marine Corps 2½-ton 6 x 6 vehicles, and during the last year and a half when it is said to have become an accepted piece of equipment for truck operators who require maximum traction. The prevention of one spinning wheel from stalling a vehicle has been the objective of automotive engineers for many years. The manufacturers say this is now accomplished.—*Thornton Tandem Co., 8701–79 Grinnell Ave., Detroit 13, Mich.*

Concrete Mixer—Outstanding features of a new concrete mixer are described in a catalog containing 38 photographs and diagrams of an 11 cu.ft. mixer. Complete dimensions and condensed specifications are given for the 2-wheel end discharge models and for the 4-wheel models offered either as end or side discharge mixers.—*Koehring Co., Milwaukee 10, Wis.*

Concrete Aggregate—An 86-page manual tells about a concrete aggregate which it is claimed has answered many of the problems of weight, acoustics, insulation, sound deadening and fireproofing. The book deals entirely with its use in building construction, devoting particular attention to applications for insulating roof fill and structural insulating roof decks.—*Universal Zonolite Insulation Co., Chicago, Ill.*

Constant Voltage—A newly-developed a-c generator for use in engine generator sets which provides general-purpose electric power at constant voltage, using a

built-in voltage regulating circuit employing the principle of series-resonance. is described in a 2-color, 4-page folder. The generator is said to maintain voltage within 2% of its rated value from no load to full load with normal engine speed regulation, and is instantly responsive to sudden load changes.—*Electric Machinery Mfg. Co., Minneapolis 13, Minn.*

Mobile Machine Shop—A booklet tells of a shop mounted on standard trucks, and including all of the equipment ordinarily assembled only in large central repair depots. Time, labor and transportation expense savings are detailed, particularly for concerns operating over extensive areas. Contractors, utilities, railways, street railway systems, highway departments, airports are regarded as principal markets.—*Davey Compressor Co., Kent, Ohio.*

Air Conditioning—Duct-type air conditioning for multi-room buildings, such as hotels, apartments, and offices, is discussed in a catalog from the standpoint of enhanced financial returns. The so-called Weathermaster system is recommended by the manufacturers for commercial buildings from one to five stories high. Each unit incorporates a convector-type radiator for steam or hot water distribution, and is of sufficient size to provide off-peak heating without operating the central fan apparatus.—*Carrier Corp., Syracuse, N. Y.*

Emergency Jack—An improved jack is described in a bulletin. It is a 15-ton capacity jack that lifts vertically and also lifts or pushes from any angle. It lifts its full rated capacity on the rotating cap, on the corrugated non-slip toe lift, on the auxiliary cap shoe that hooks on the cap in two positions, and on the lifting chain, any link of which can be engaged in a recess in the cap. The toe lift minimum is only 2¼", and the double lever socket adequately provides for operation in close quarters.—*Templeton, Kenly & Co., 1020 South Central Ave., Chicago 44, Ill.*

Water softening—A booklet contains seven architectural flow diagrams presenting a representative cross section of the various types of water-treatment problems encountered and how they were solved. These diagrams have to do with softening water for industrial use, for waste treatment, for sewage disposal, and for pre-treatment of boiler water. *W. H. and L. D. Betz, Philadelphia 24, Pa.*

Materials Handling—Of interest to those engaged in the designing, purchasing or use of materials handling equipment is an 8-page booklet entitled "Cone-Drive Gearing At Work In Materials Handling." Action photographs with explanatory diagrammatic sketches il-

Time out for Flats?

Today's stepped-up construction program demands unfailing performance from all construction equipment. There's no time on your schedules for fixing flats.

FAILURE-PROOF TUBE REPAIRS IN 15 TO 18 MINUTES on large breaks

In your own shop . . . or on the job . . . make truck and tractor tube repairs that are failure-proof . . . that stand up under tough conditions, both on and off the road. The new Inland Tube Vulcanizing Unit does a thoroughly safe and dependable job of tube repairs—faster and more economically. Large breaks repaired in 15 to 18 minutes. Handles tube injuries up to six inches long in one curing, on both natural and synthetic rubber, plus all sizes of valve stem repairs and replacements.

This new Unit consists of Inland's famous thermostatically controlled vulcanizing press PLUS a complete stock of gum, vulcanizing cement, accessories and tools. Easy to use; no experience necessary. Your automotive jobber has these Units in stock for immediate delivery. Inland Rubber Corporation, 33 So. Clark St., Chicago 3, Illinois. A subsidiary of Minnesota Mining and Manufacturing Company.

BE SAFE USE INLAND

Inland Rubber Corp.
33 So. Clark St.,
Dept. E27, Chicago 3, Ill.

INLAND

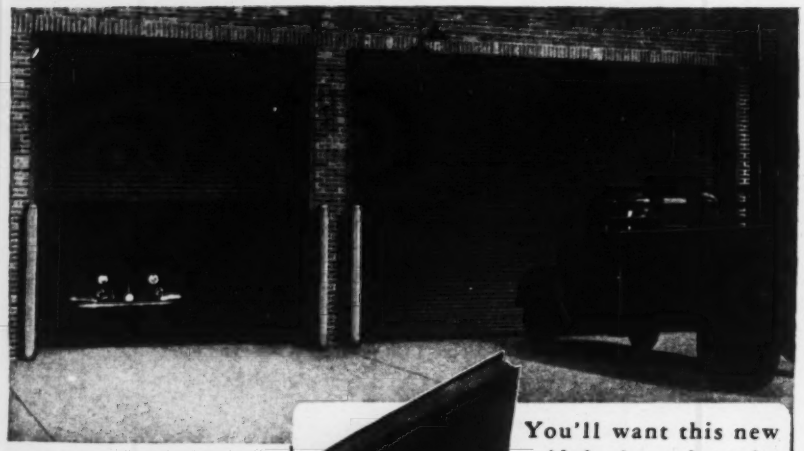
Please send me complete information concerning the Inland Tube Vulcanizing Unit.

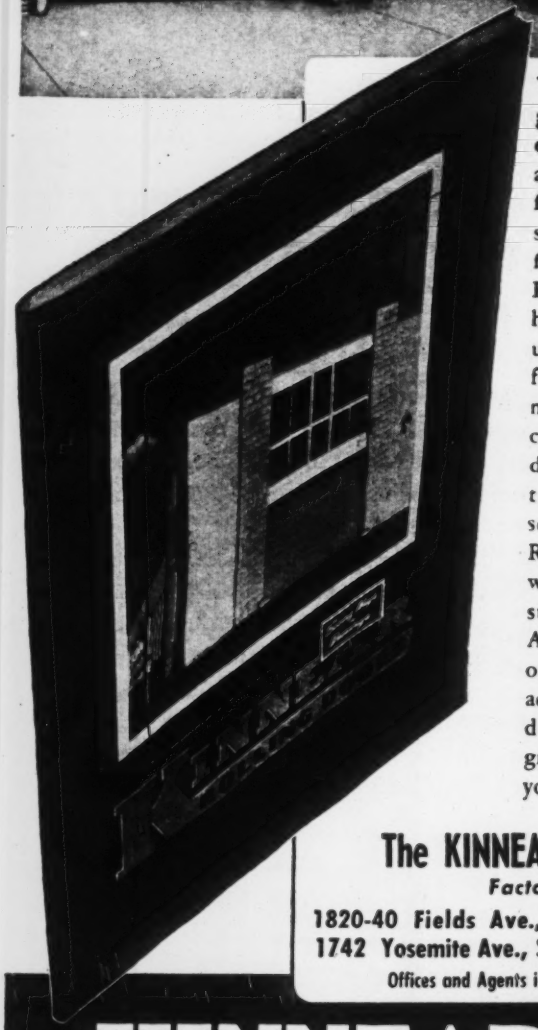
Name.....

Address.....

Town.....

LATEST COMPLETE DATA on EFFICIENT, UPWARD ACTING DOORS





You'll want this new guide-book on doors for every need! It gives you all the up-to-the-minute facts on the quick, space-saving, dependable performance of Kinnear Rolling Doors . . . shows how the smooth, coiling, upward action of the famous, Kinnear-originated, interlocking-slat construction assures *extra* door satisfaction. Full details on the popular sectional-type Kinnear RoL-TOP doors, of either wood or all-steel construction, are included. Also latest data on many other types of upward-acting fire doors, service doors, and protective grilles. Write today for your free copy!

The KINNEAR Mfg. Co.

Factories:

1820-40 Fields Ave., Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.

Offices and Agents in All Principal Cities

KINNEAR ROLLING DOORS

SAVING-WAYS in DOORWAYS

lustrate the equipment for material-handling in which cone-drive double enveloping gearing is now being used. Illustrations also indicate how the gearing has been engineered into the particular job in order to obtain maximum operating benefits. Included are cranes; hoists; capstans; winches; lift trucks; electric shovels, etc.—*Michigan Tool Co., 7171 E. Nichols Road, Detroit 12, Mich.*

Sludge Reactivator—A complete description and operating explanation of a sludge blanket type reactivator is contained in an 8-page illustrated bulletin. It portrays the principles and advantages of upward sludge filtration and describes its adaptability to the effective treatment of both industrial and municipal water supplies. Charts, flow diagrams, and cut-away drawings show how this equipment can soften and clarify raw water, materially reduce reaction time, and provide a treated water that, in many cases, is suitable for process use without further treatment.—*Graver Tank & Mfg. Co., Inc., 332 South Michigan Avenue, Chicago, Ill.*

Flow Rate Measurement—A bulletin describes a line of fixed and portable manometers for use in water surveys and similar flow rate measurements. Also included are valuable engineering data on manometers.—*Simplex Valve & Meter Co., 6751 Upland Street, Philadelphia 42, Pa.*

Diesel Engines—A 12-page catalog features a new line of diesel engines for automotive, industrial, and marine service. Illustrations show 1, 2, 3, 4, 6, and 8-cylinder models, ranging from 15 to 300 hp. Material in the catalog includes pressure lubrication data, a discussion of a slow pressure combustion system, engine data table and other information on the application of the new diesels.—*The Buda Co., Harvey, Ill.*

Solid Partitions—A booklet tells of 2-in. solid partitions which are said to save enough space and weight to reduce the strength and weight of the framework and foundation required. They have a full hour or better fire rating, low maintenance and first cost. They are useful as non-bearing walls in factories, offices, apartments, hospitals, stores, etc.—*National Gypsum Co., Buffalo 2, N. Y.*

Bulldozers and Tractors—A bulletin describes and illustrates a bulldozer and auxiliary equipment which may be installed on gas or diesel tractor units fitted with heavy duty or standard front end axles. These units have been developed with the cooperation of the engineering department of the International Harvester Co.—*Contractor Machinery Co., Inc., Batavia, N. Y.*

Planning to buy new equipment?

Plan, too, to protect it with DOUBLE-DUTY OIL!

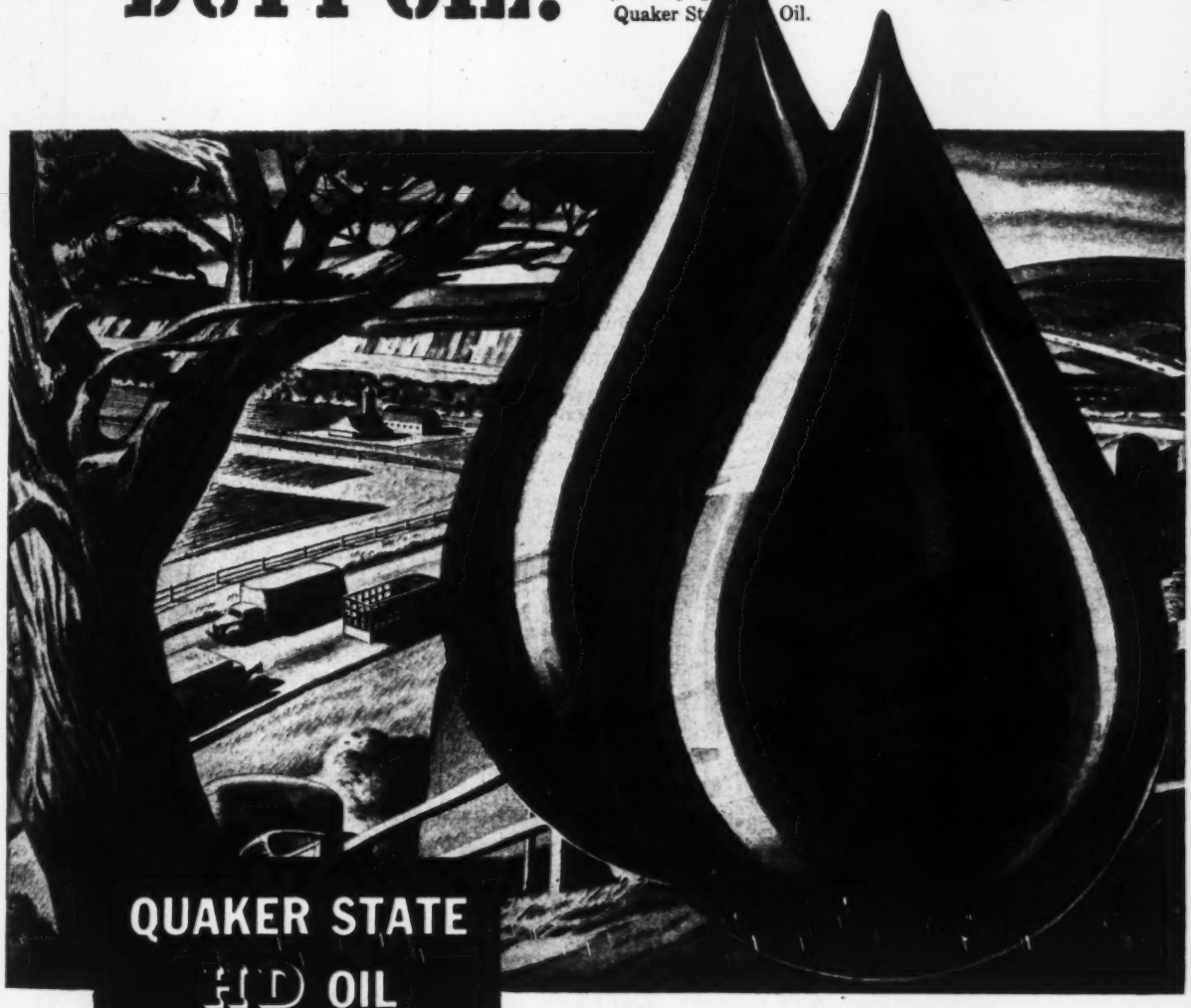
IF you are planning to buy new buses, trucks, or tractors, it will pay you to make Quaker State HD Oil part of your plan . . .

Remember that Quaker State HD Oil is the DOUBLE-DUTY oil that did so much to keep hard-working engines running in top-notch condition during the past four years, when the going was really tough. It's the oil that not only kept them lubricated better, but kept them *cleaner*.

Quaker State HD Oil contains a wonderful detergent that keeps vital working surfaces free from clogging, trouble-making dirt, carbon, sludge, and sticky varnish.

So you get better engine efficiency, with less maintenance expense, less worry, longer equipment life.

If you want your new equipment to give you the best service at lowest cost, give it the protection that only a really good DOUBLE-DUTY oil can give. Give it Quaker State HD Oil.



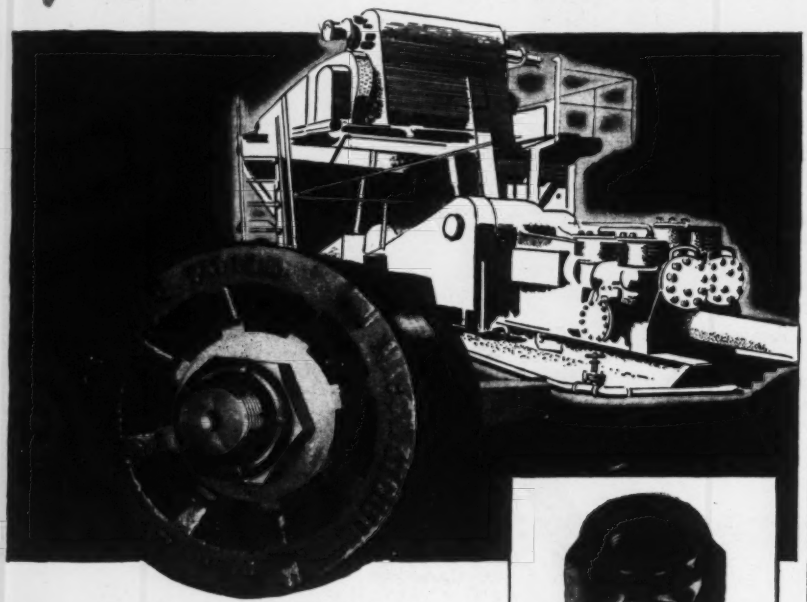
Quaker State HD Oil for your trucks, buses, and tractors
Quaker State Motor Oil for your passenger cars

QUAKER STATE OIL REFINING CORPORATION • OIL CITY, PENNSYLVANIA

2,500 PSI

Reciprocating Action

ON SLUSH PUMPS



— yet the Red Elastic Collar protects permanently against VIBRATION

Vibration — caused by alternate suction and pressure that reached 2,500 psi — made complex trouble spots for the 1½" to 2" nuts that held slush pump pistons on the rod. Other types of *conventional* fasteners failed. ESNA Elastic Stop Nuts held permanently!

In addition to holding permanently against Vibration, ESNA Elastic Stop Nuts protected against Liquid Seepage. Abrasive mud could not get between the nut and rod to cut out the piston and core rod. They prevented Thread Corrosion. They prevented Costly Maintenance during piston replacement because they are self-locking, easily removable, and reusable over and over.

Here's a challenge: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts — FREE, in experimental quantities. For further information or literature address: Elastic Stop Nut Corporation of America, Union, New Jersey. Representatives and Agents are located in principal cities.

The RED ELASTIC COLLAR

—denoting an ESNA product

. . . is threadless and permanently elastic. Every bolt — *regardless of commercial tolerances* — impresses (does not cut) its full thread contact in the Red Elastic Collar to fully grip the bolt threads. In addition, this threading action properly seats the metal threads — and eliminates all axial play between bolt and nut threads.

All ESNA Elastic Stop Nuts — *regardless of size or type* — lock in position anywhere on a bolt or stud. Vibration, impact or stress reversal cannot disturb prestressed or positioned settings.

ESNA

ELASTIC STOP NUTS

INTERNAL WRENCHING · ANCHOR · INSTRUMENT MOUNTING · SPLINE · CLINCH · GANG CHANNEL

PRODUCTS OF: **ELASTIC STOP NUT CORPORATION OF AMERICA**

Men and Jobs

Appointment of **J. Lyle Cunningham** of Boise, Idaho, and **Harold T. Nelson** of Yakima, Wash., as assistant regional directors in the Northwest office of the Bureau of Reclamation at Boise, Idaho, has been announced by R. J. Newell, regional director.

J. L. Cunningham

Cunningham, who has been serving as an assistant to the director, moves up to his new position where he will take over duties in connection with administration and organization phases of the bureau's activities. He will deal particularly with finance, personnel, supply, information, land acquisition, and progress control.

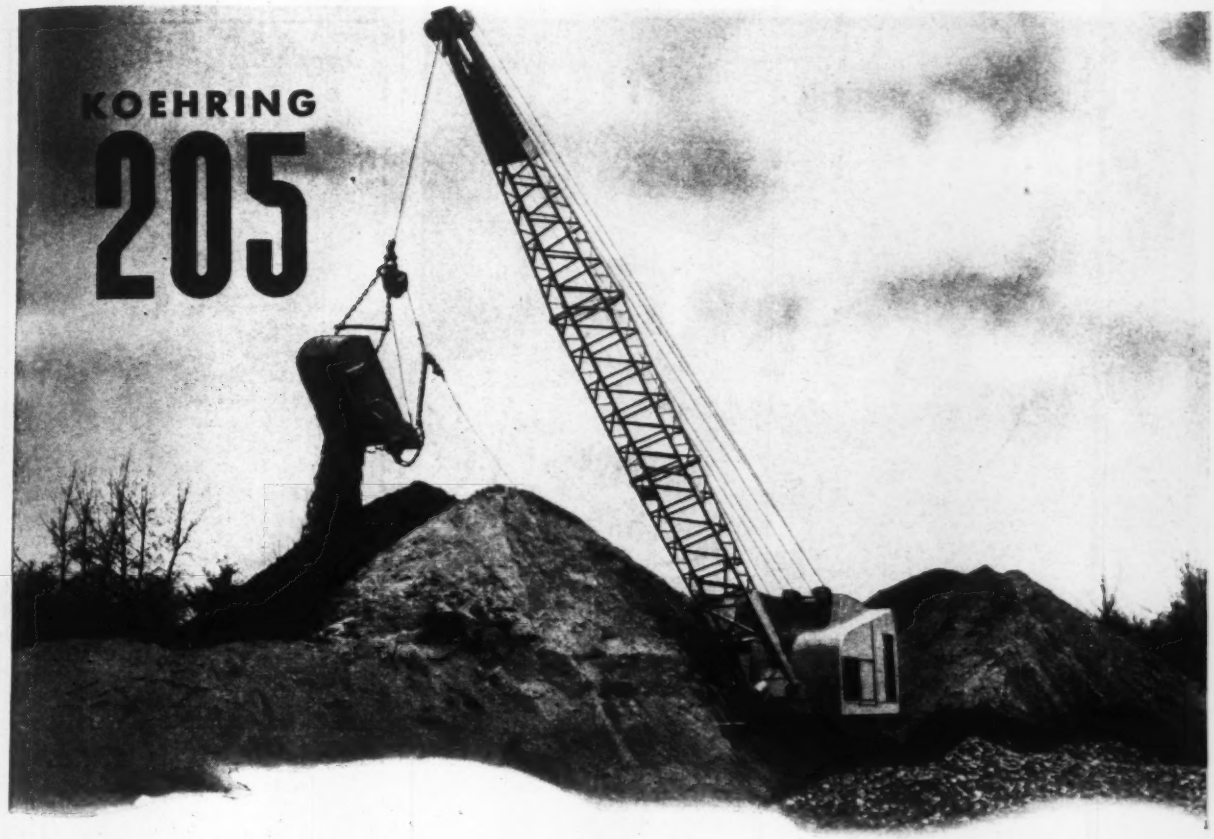
Mr. Nelson, who has been construction engineer of the bureau's Roza Division of the Yakima Project in south central Washington, will join the regional office. He will be responsible for all technical phases of the bureau's activities in construction, project planning, operation and maintenance, and power.

In announcing Mr. Nelson's appointment, Mr. Newell said that **H. W. Pease**, now with the Branch of Project Planning in Boise, will be appointed to replace Nelson on the Yakima construction job. Pease is well known in the Yakima region, having served the Bureau there for a number of years. He is a graduate of Dartmouth and the Thayer School of Civil Engineering.

Harold T. Nelson

Assistant Regional Director Nelson has been with the Bureau since January 1936, joining the organization as an employee in the Denver office. He went to Yakima in May 1937 as an assistant engineer.

Charles R. Velzy has joined the consulting engineering firm of Buck, Seifert and Jost of New York City, where he will have charge of sewage works design and supervision of construction. Associated for many years with the Chicago consulting engineering firm of Greeley and Hansen, he has been in charge of their New York office for the last few years.



A TOUGH GO-GETTING HALF-YARD

because it's KOEHRING HEAVY-DUTY

EVEN without the name plate you can tell the 205's a Koehring . . . every detail says: "Heavy-Duty". This means to you: Toughness to stand up to any job the future may bring, lower maintenance cost, more output, bigger earnings.

And don't think because the 205 is exceptionally rugged and strong that it's slow and cumbersome. It's ALL modern . . . the first half-yard built by Koehring . . . all new from the ground up. It's fast, convenient, alert in response to controls. Quality materials are used and dead weight is engineered out so as to combine speed with strength.

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About District Engineers

Col. Robert G. Lovett, Corps of Engineers, U. S. Army, has been assigned district engineer of the Vicksburg Engineer District. Going to Vicksburg from Fort Leonard Wood, Mo., where he commanded the Army Service Forces training center, Colonel Lovett replaces **Lt. Col. R. W. Sauer,** C. E., who remains as executive assistant.

Colonel Lovett was graduated from West Point in 1918, in the Corps of Engineers. After serving in the Philippines and Hawaii from 1920 to 1923 he returned to be executive officer of the Chattanooga Engineer District from 1929 to 1931, and as executive officer for the Division Engineer of the Gulf of Mexico Division from 1936 to 1939. Serving for a year as District Engineer of the First New Orleans District, Colonel Lovett then went to Jamaica, British West Indies, as district engineer there. In 1944 he took command of an Engineer combat group for the 12th Corps, Third Army, and later served with the Corps of Engineers of the 20th Corps. He returned in October of 1945 and took command of the Army Service Forces Training Center at Fort Leonard Wood, Mo., where he served until ordered to Vicksburg.

Col. James D. Lang formerly in Seattle, Wash., has been appointed district engineer of the new Alaska Engineer District, with headquarters at Anchorage. He is charged with military construction and army real estate activities in the Territory of Alaska.

Colonel Lang was graduated from West Point in 1935 and received a master's degree in civil engineering at the University of Iowa in 1937. After serving at Forts Logan, Lewis, Ord and Belvoir, he was sent to Seattle in 1938 as resident engineer for the construction of Mud Mountain Dam. In 1943 he was sent to Alaska as executive officer of the staff engineer, later becoming engineer for the Alaskan Department in charge of military construction, engineer troop activities and repairs and utilities.

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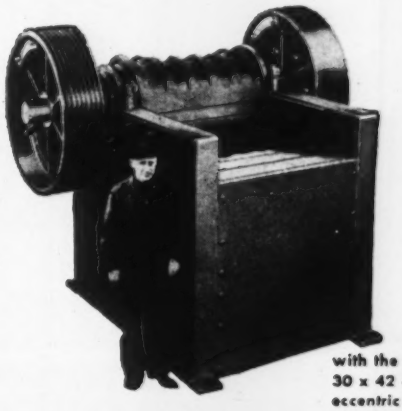
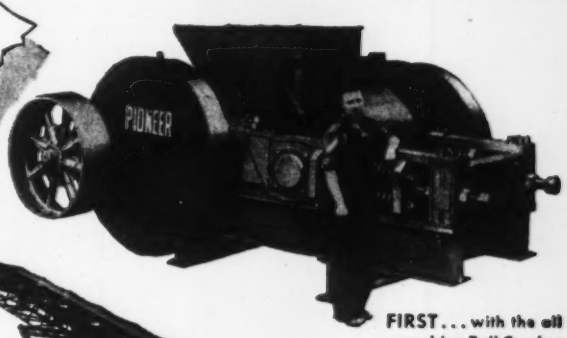
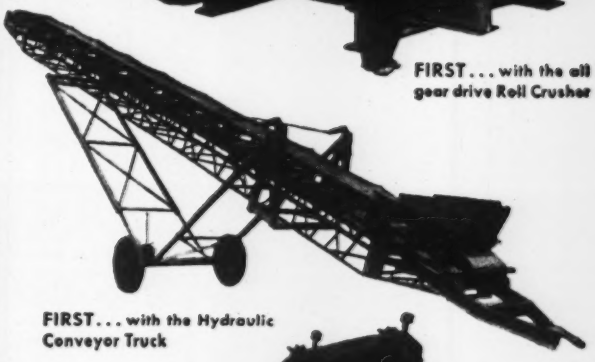


FIRST... with the 24 x 36 and 30 x 42 overhead eccentric Jaw Crusher



FIRST... with the all gear drive Roll Crusher



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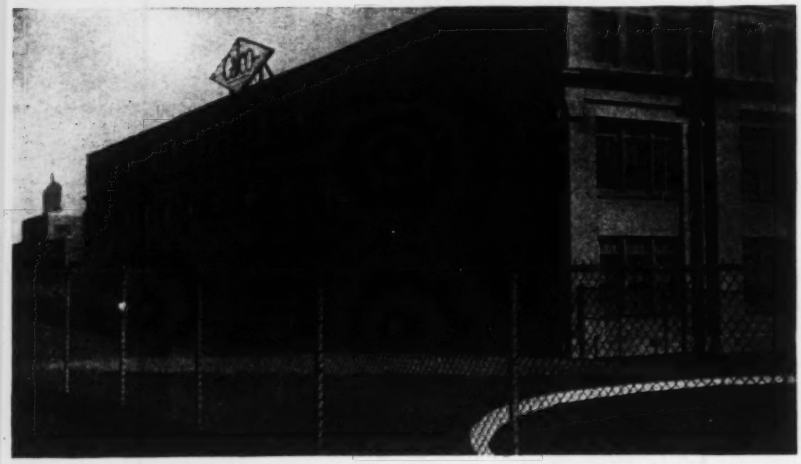

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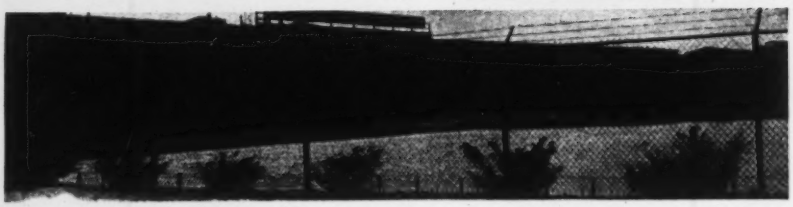

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Elections and Activities

C. M. Shafer, New Philadelphia, has been elected president of the Ohio Brick and Tile Institute, succeeding P. W. Hartung, Canton, named a member of the board of directors. O. J. Buehler, Zoarville, was named vice president, and R. Hunter Cochran, Canton, continues as executive secretary. The board of directors comprises, in addition to Mr. Hartung, Mr. Schafer and Mr. Buehler, the following: Forrest Tefft, Columbus; D. J. Renkert, Canton; and C. S. Finzer, Sugar Creek.

C. B. Beyer, of the Ross-Beyer Engineering Co., Albuquerque, was re-elected president of the New Mexico Society of Engineers at a recent annual meeting in Albuquerque. Other officers named include: W. J. Bratschi, Santa Fe, vice-president; W. C. Wagner, Albuquerque, secretary-treasurer; C. G. Grosvenor, Santa Fe, and R. A. Pierce, Carlsbad, Directors for two-year terms; E. M. Conwell, Albuquerque, and E. B. Van de Greyn, Santa Fe, directors for three-year terms.

Engineers, federal and state highway officials, and materials and equipment representatives attended the recent tenth annual highway conference at Albuquerque, N. M., where a number of aspects of New Mexico's construction program were considered. Speakers included A. J. Ryan, consulting engineer, Denver, Colo., on western traffic problems and highway-building; Jess E. Williams, Santa Fe, district engineer for U. S. Public Roads Administration, on "Economic Aspects of Highway Location and Design;" Lieut. Col. R. E. Cole, district engineer at Albuquerque for U. S. Engineers, on flood control of the middle Rio Grande; and John L. Mutz, acting area engineer at Albuquerque for the Bureau of Reclamation, on economic results of projected development of New Mexico's water resources.

Officers of the St. Louis, Mo., Engineers Club have been inaugurated as follows: President, Brig. Gen. Leif J. Sverdrup of Sverdrup & Parcel, St. Louis; 1st vice-president, J. M. Chandlee; 2nd vice-president, B. R. Smith; 3rd vice-president, R. E. Salveter; treasurer, S. S. Marsden. C. W. S. Sammelman was retained as secretary. Three new directors were elected: R. J. Grote, district manager and structural engineer for Banner Iron Works; J. W. Hubler, associate

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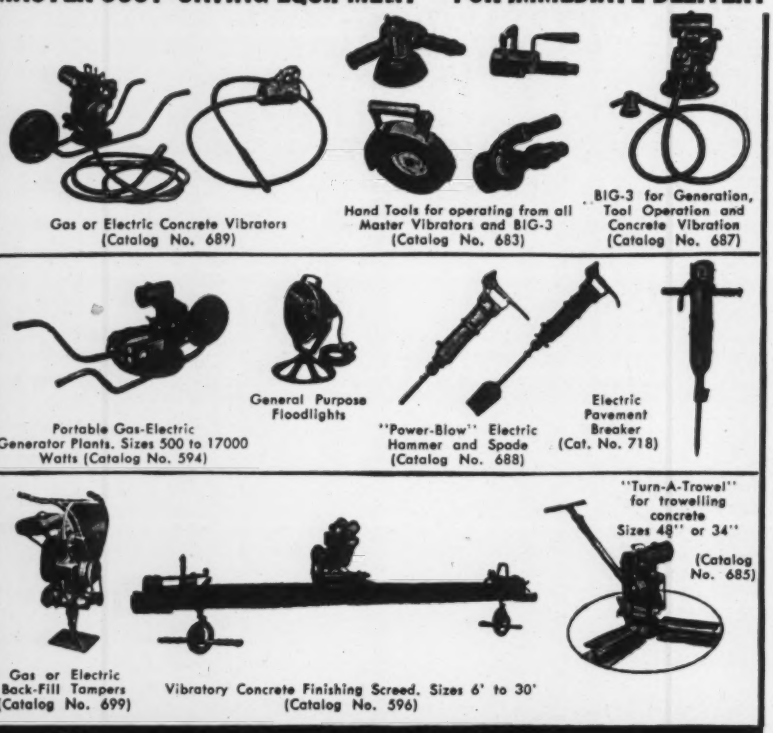

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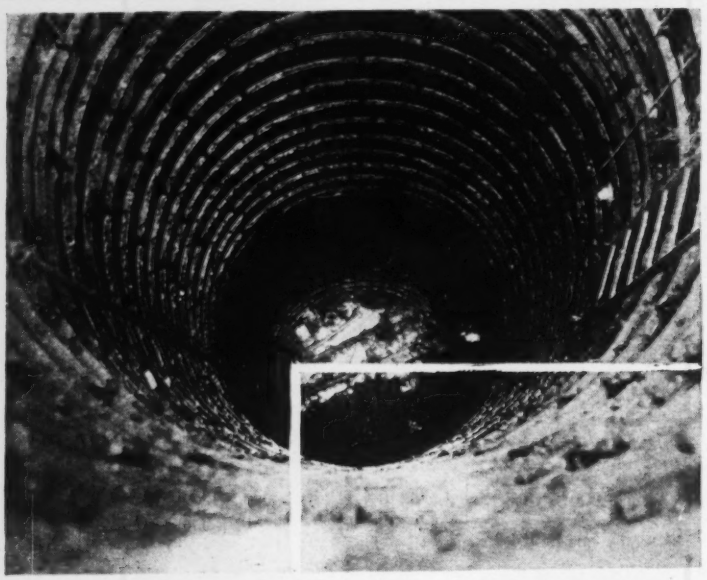

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professor of civil engineering at Washington University; and L. L. Kraft, mechanical supervisor of Union Electric Co. of Illinois.

The Texas section of the American Society of Civil Engineers has awarded life memberships to L. R. Ferguson and J. Z. George, Dallas; Charles Schultz, Richmond; C. D. Ashbrook, San Antonio; A. J. McKenzie, SanAntonio; C. M. Davis, Fort Worth; W. C. Mundt, Port Arthur; and S. L. McGlathery, Galveston.

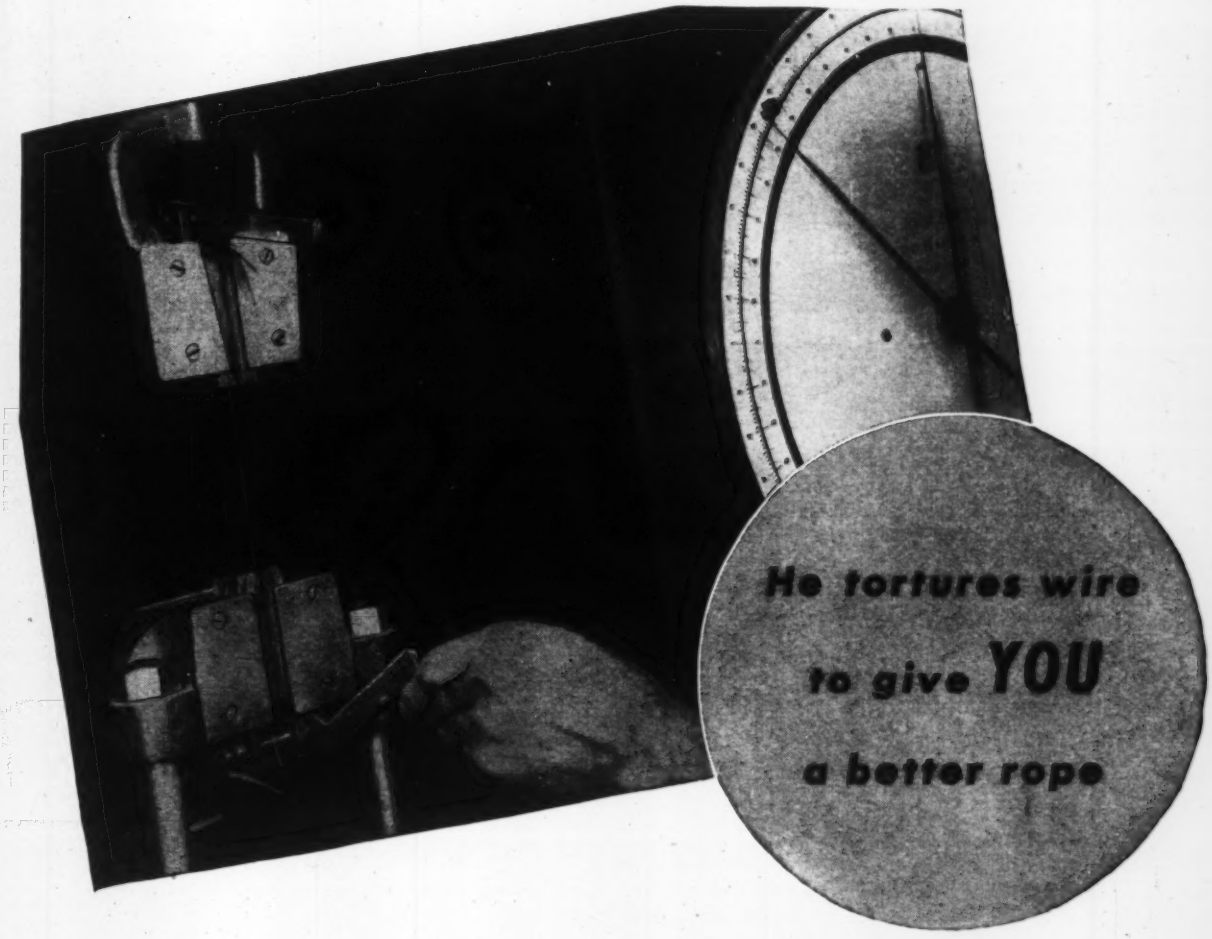
L. O. Bass of Saint John, N. B., has been elected chairman of the N. B. Branch of the Engineering Institute of Canada, succeeding G. M. Lamb. Other officers elected were: David R. Smith, vice chairman; K. W. Salmon, secretary-treasurer; D. O. Turnbull and W. D. MacDonald, executive members.

Gordon Beiswanger of Billings has been elected chairman of the Montana section, American Water Works Association, with Stewart Voden of Great Falls as vice-chairman and J. B. Hazen, Butte, and B. F. Mercer, Sidney, trustees. C. W. Brinck, Helena, was named secretary-treasurer to replace H. B. Foote, who had held that position ever since the organization of the section in 1926, with the exception of one year when he was chairman.

Blair Birdsall, assistant chief engineer of the bridge division of the John A. Roebling's Sons Co. has been elected president of the Engineers' Club of Trenton, N. J. The following also were elected: Roger J. Evans, first vice president; Joseph P. Clark, second vice president; Arthur D. Bullock, treasurer, and Fred C. Claus, secretary.

W. A. Beaubein, Phoenix contractor, has been elected president of the Building Contractors of Arizona. He succeeds J. R. Porter. Other officers elected are J. A. Brown, first vice president; H. C. Catlin, second vice president; Cecil Apperson, secretary, and Louis Karpe, treasurer.

Officers of the Arizona Sewage and Water Works Association have been elected as follows: President, Robert M. Cushing, Phoenix, succeeding Prof. E. S. Borgquist, head of civil engineering department, University of Arizona, Tucson; 1st vice-president, Harold W. Yost, Phoenix, reelected; 2d vice-president, John Rauscher, engineer, water department, Tucson, succeeding A. W. Miller, Phoenix; secretary-treasurer, George W. Marx, director Sanitary Engineering Division, Arizona State Board of Health, Phoenix, reelected; and directors, the



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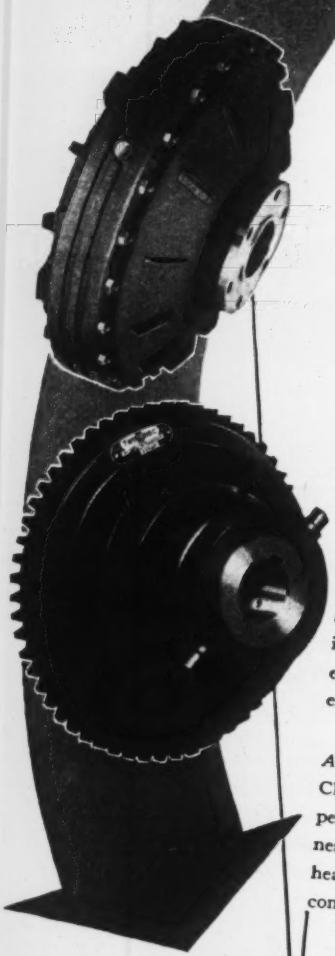

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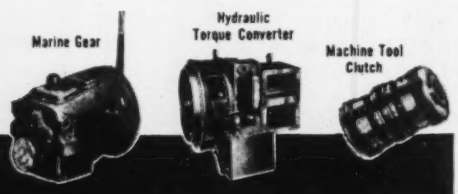

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officers and G. A. Rhoads, Safford; L. F. Brown, Williams; A. W. Miller, Phoenix; Dario Travaini, Phoenix.; and ex officio members, past presidents E. S. Borgquist and H. H. Idle, Phoenix. A. L. Frick, was chosen for a 3-year term as member of the board of control of the National Federation of Sewage Works Associations.

C. F. Lovan, of the engineering firm of Hillyer and Lovan, Jacksonville, has been elected president of the Northeast Florida chapter of the Associated General Contractors of America. He succeeds Ivy H. Smith. James T. Monahan, of the George D. Auchter Co. of Jacksonville, was re-elected secretary-treasurer.

Alex E. Brest of Jacksonville, has been elected president of the Florida Road Builders' Association. W. Harry Armston of Dunedin was named vice president and R. L. Bannerman of Tallahassee, secretary-treasurer. The organization was formerly known as the Florida Section, American Road Builders Association.

C. O. Gilliam, city engineer, has been elected president of the new Yuma, Ariz., Engineers Club.

G. Brooks Earnest, associate professor of civil engineering at the Case School of Applied Science, is the new president of the Cleveland, Ohio, Technological Societies Council. Other officers are A. E. Wilson, vice-president; Prof. G. L. Tuve, secretary; and Don E. Inman, treasurer.

Edmund Friedman, of Miami, has been elected president of the Florida Engineering Society. Other officers: M. B. Garris, Miami, first vice-president; W. W. Gillespie, Jacksonville, second vice-president; David B. Lee, Jacksonville, secretary; and Raymond Chase, Jacksonville, treasurer.

Titus G. LeClaire, chief staff engineer, Commonwealth Edison Co., Chicago, Ill., has been elected president of the Western Society of Engineers, succeeding Henry T. Heald, president, Illinois Institute of Technology. Verne O. McClurg, consulting engineer, Chicago, was elected second vice-president, and William H. Kahler, Illinois general manager of the Illinois Bell Telephone Co., was advanced from second to first vice-president. Honorary memberships in the society were presented to Charles B. Burdick and William S. Monroe, consulting engineers, Chicago, at the recent 77th annual meeting. Ovid W. Esbach, dean of the Northwestern Technological Institute, received the Octave Chanute Medal, awarded annually for the best paper presented before the society.

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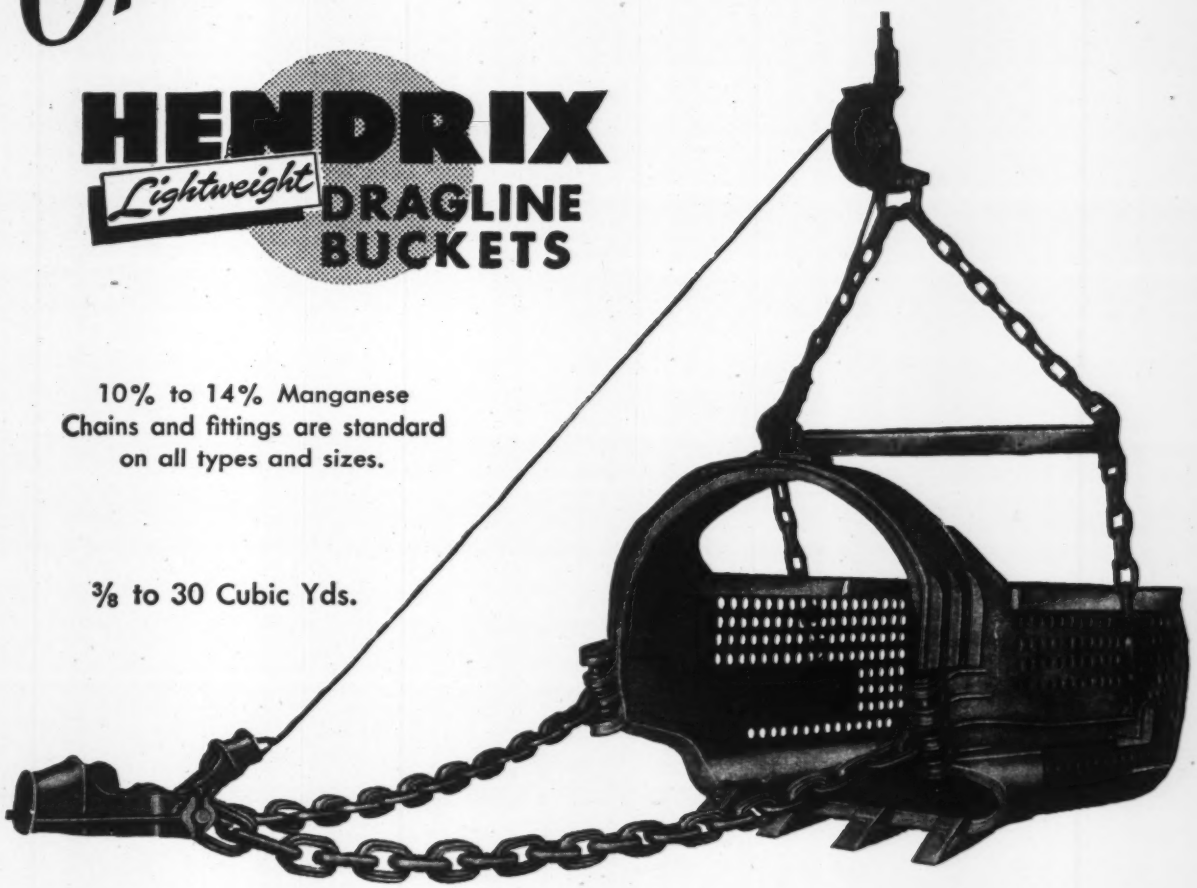

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- ★ All welded construction for greater strength and durability.
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Honorary membership in Tau Beta Pi, national honor association of engineers, was conferred on Harold S. Ellington and Col. Herbert W. Alden at the recent annual meeting of the Detroit, Mich., chapter. They were chosen from a group of thirty nominees, upon the recommendation of a committee of past presidents of the chapter, in recognition of their outstanding contributions to the field of engineering.

The Dominion Council of Professional Engineers has re-elected P. Burke-Gaffney, of Winnepeg, Man., president. M. Ackroyd, of Toronto, Ont., vice-president, and Barry Watson, Toronto, secretary-treasurer. Additional members of the executive board: W. P. Dobson, of Toronto, and Paul Poitras, of Montreal.

H. O. Walberg, Skagit County engineer at Mount Vernon, Wash., has been elected president of the Washington State Association of County Engineers. A. G. Hanson of Klickitat County is vice-president and Charles Neville of Lewis County, secretary-treasurer.

W. J. Manthey has been elected president of the Juneau Contractors' and Employers' Association at Juneau, Alaska, with Hans Berg, first vice-president. Ken McLeod, second vice-president, Cliff Berg, secretary and James Larsen, treasurer.

The District of Columbia Society of Professional Engineers has elected these new officers: Herbert Manuccia, Alexandria, Va., president, succeeding Frederick W. Hill, C. Warren Rogan as first vice-president with John J. Rockefeller, second vice-president. Ralph A. Dane was elected secretary-treasurer. George B. Roberts and Maj. Elmer C. Kautt were chosen for the board of directors. Mr. Hill was elected national director.

The Syracuse, N. Y., Post of the Society of American Military Engineers has elected the following officers: president, Robert F. Petrosek; vice-president, Albert P. Pollman; secretary, Achilles M. Tuchtan; and treasurer, George F. Richardson.

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